

EXHIBIT 29



Flexural Report Page 1 of 4

Testing : Flexural Properties Of Plastics
 Test Method : ASTM D790-03 Procedure A
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : L. Howland
 Date : May 22, 2007

Attachments : 1 Page Of Photos



Sample Preparation : Tested as received
 Sample Dimensions : 0.497" x 0.128" x 6.00" (Average)
 Sample Type : ASTM Flex Bar
 Span Length (in) : 2.080
 Cross-Head Speed (in/min) : 0.055
 Span-To-Depth Ratio : 16±1:1
 Radius Of Supports (in) : 0.197
 Radius Of Loading Nose (in) : 0.197
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : ASTM D 790 specifies modulus and strength be reported to 3 significant figures

Sample Name	Test Number	Flexural Stress At 5%	Flexural Modulus
		Strain (PSI)	(tangent *) (PSI)
MDI Prepolymer	1	596	13600
	2	473	11200
	3	573	13100
	4	523	12100
	5	536	12300
	Average	540	12500
	Std. Dev.	47	929
Estonia Bland	1	729	16900
	2	711	16100
	3	726	16600
	4	763	17600
	5	704	16100
	Average	727	16700
	Std. Dev.	23	627

* = computer generated curve fit

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Flexural Report Page 2 of 4

Testing : Flexural Properties Of Plastics
 Test Method : ASTM D790-03 Procedure A
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : L. Howland
 Date : May 22, 2007



Sample Preparation : Tested as received
 Sample Dimensions : 0.498" x 0.131" x 6.00" (Average)
 Sample Type : ASTM Flex Bar
 Span Length (in) : 2.080
 Cross-Head Speed (in/min) : 0.055
 Span-To-Depth Ratio : 16±1:1
 Radius Of Supports (in) : 0.197
 Radius Of Loading Nose (in) : 0.197
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : ASTM D 790 specifies modulus and strength be reported to 3 significant figures

Sample Name	Test Number	Flexural Stress At 5%	Flexural Modulus
		Strain (PSI)	(tangent *) (PSI)
8940	1	2180	50800
	2	2160	51200
	3	2160	50300
	4	2140	48100
	5	2170	50000
	Average	2160	50100
	Std. Dev.	15	1200
Texin Blend	1	267	5120
	2	268	5150
	3	264	5120
	4	247	4750
	5	282	5370
	Average	266	5100
	Std. Dev.	13	223

* = computer generated curve fit

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Flexural Report Page 3 of 4

Testing : **Flexural Properties Of Plastics**
 Test Method : ASTM D790-03 Procedure A
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : L. Howland
 Date : May 22, 2007



Sample Preparation : Tested as received
 Sample Dimensions : 0.499" x 0.130" x 6.00" (Average)
 Sample Type : ASTM Flex Bar
 Span Length (in) : 2.080
 Cross-Head Speed (in/min) : 0.055
 Span-To- Depth Ratio : 16±1:1
 Radius Of Supports (in) : 0.197
 Radius Of Loading Nose (in) : 0.197
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : ASTM D 790 specifies modulus and strength be reported to 3 significant figures

Sample Name	Test Number	Flexural Stress At 5% Strain (PSI)	Flexural Modulus (tangent*) (PSI)
Blend 2	1	2380	56800
	2	2360	54700
	3	2340	54800
	4	2400	55900
	5	2430	57700
	Average	2380	56000
	Std. Dev.	35	1290
Blend 3	1	2330	54500
	2	2320	53800
	3	2280	52300
	4	2250	51200
	5	2300	52800
	Average	2300	52900
	Std. Dev.	32	1290

* = computer generated curve fit

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Flexural Report Page 4 of 4

Testing : Flexural Properties Of Plastics
 Test Method : ASTM D790-03 Procedure A
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : L. Howland
 Date : May 22, 2007



Sample Preparation : Tested as received
 Sample Dimensions : 0.499" x 0.131" x 6.00" (Average)
 Sample Type : ASTM Flex Bar
 Span Length (in) : 2.080
 Cross-Head Speed (in/min) : 0.055
 Span-To- Depth Ratio : 16±1:1
 Radius Of Supports (in) : 0.197
 Radius Of Loading Nose (in) : 0.197
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : ASTM D 790 specifies modulus and strength be reported to 3 significant figures

Sample Name	Test Number	Flexural Stress At 5%	Flexural Modulus
		Strain (PSI)	(tangent *) (PSI)
Blend 4	1	2180	50300
	2	2210	50900
	3	2110	48700
	4	2170	49200
	5	2190	50000
	Average	2170	49800
	Std. Dev.	38	876

* = computer generated curve fit

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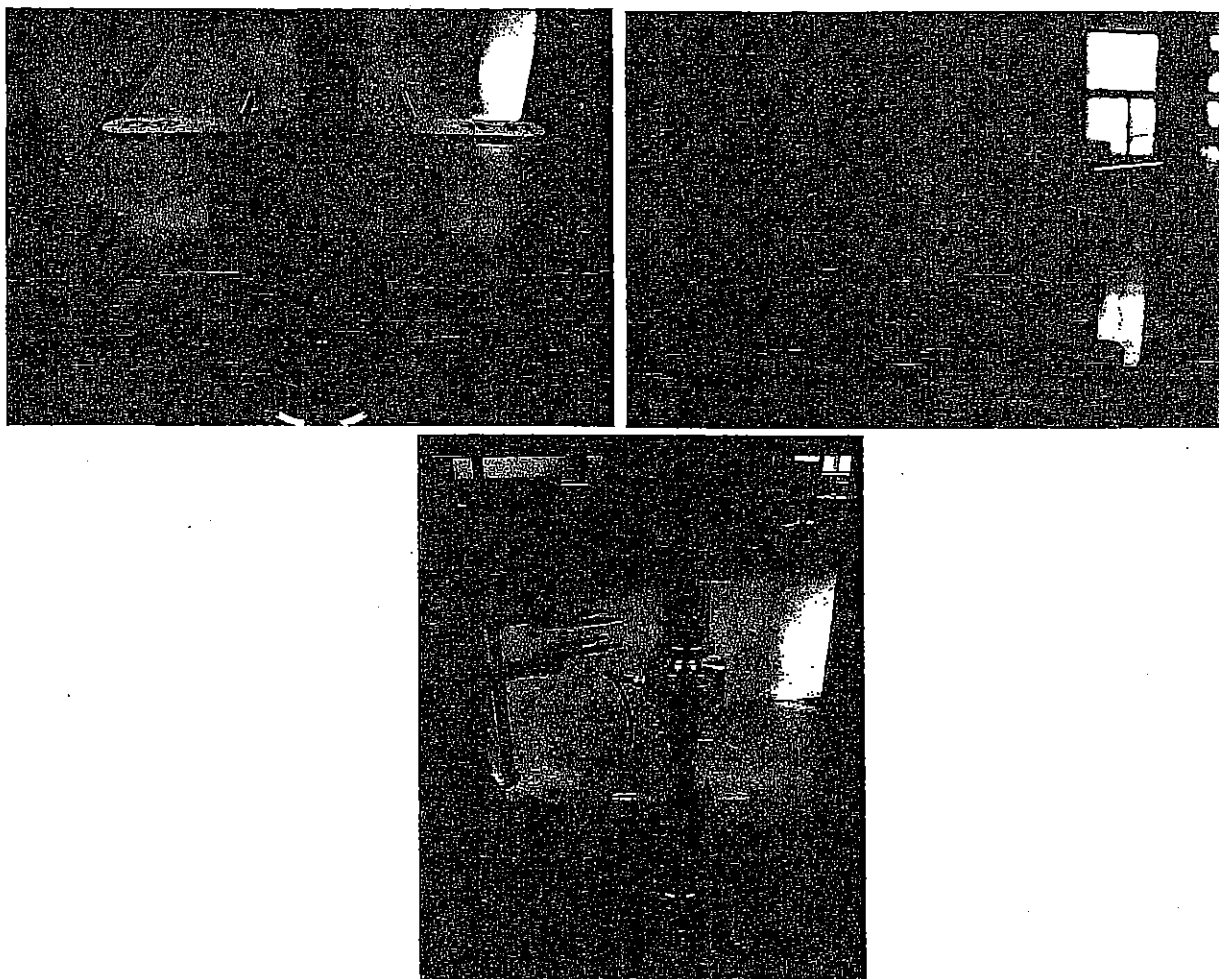
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Photos Report Page 1 of 1

Testing	: Flexural Properties Of Plastics
Test Method	: ASTM D790-03 Procedure A
Project Number	: P20071713
Customer	: Acushnet Company
Attention	: Troy Lester
Analyst	: L. Howland
Date	: May 22, 2007



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Durometer Hardness Report Page 1 of 7

Testing : Rubber Property - Durometer Hardness
 Test Method : ASTM D2240-05 - Modified test specimen - golf ball
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : J. McCarthy
 Date : May 22, 2007

Attachments : 1 Page Of Photos



Specimen Preparation : Tested as received
 Test Location : Tested between dimples
 Tested Thickness : N/A
 Durometer Type : Zwick Digital 7206.07 (Shore D S/N 110129)
 Indentation Time Interval : 1.0 Second
 Indenter Used : "D"
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Set 1		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID		1	2	3	4	5			
1		60.5	62.5	59.9	58.7	59.7	60.3	1.4	2.3
2		59.9	61.5	61.1	62.1	59.9	60.9	1.0	1.6
3		62.3	61.9	62.7	61.3	62.5	62.1	0.6	0.9
4		64.5	64.3	63.5	61.7	63.3	63.5	1.1	1.7
5		64.1	63.1	62.5	63.7	62.5	63.2	0.7	1.1
6		62.5	64.1	62.5	59.9	60.9	62.0	1.6	2.6
7		64.1	62.7	63.1	63.3	63.9	63.4	0.6	0.9
8		61.7	62.3	61.9	62.9	62.5	62.3	0.5	0.8
9		61.9	62.1	59.9	62.1	59.9	61.2	1.2	1.9
10		61.9	62.1	61.5	61.3	61.3	61.6	0.4	0.6
11		60.9	62.1	61.7	63.5	60.9	61.8	1.1	1.7
12		60.5	62.3	61.9	61.9	60.5	61.4	0.9	1.4
Overall Totals							62.0	1.3	2.1

Set 2		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID		1	2	3	4	5			
1		56.9	57.5	57.5	57.7	58.5	57.6	0.6	1.0
2		56.7	56.1	57.1	56.9	56.9	56.7	0.4	0.7
3		56.5	57.3	56.1	56.5	57.5	56.8	0.6	1.0
4		57.7	57.5	57.1	56.3	56.9	57.1	0.5	1.0
5		57.3	56.3	56.9	57.5	56.9	57.0	0.5	0.8
6		55.1	55.7	55.9	55.5	55.7	55.8	0.5	0.9
7		49.9	50.5	50.7	50.3	51.1	50.5	0.4	0.9
8		54.5	55.1	55.9	54.9	55.1	55.1	0.5	0.9
9		54.7	53.5	53.9	54.3	54.1	54.1	0.4	0.8
10		56.3	57.7	58.3	57.5	56.9	57.3	0.8	1.3
11		56.1	56.9	57.1	56.3	56.1	56.5	0.5	0.8
12		57.3	56.3	56.7	57.1	56.9	56.9	0.4	0.7
Overall Totals							56.0	2.0	3.5

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Durometer Hardness Report Page 2 of 7

Testing : Rubber Property - Durometer Hardness
 Test Method : ASTM D2240-05 - Modified test specimen - golf ball
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : J. McCarthy
 Date : May 22, 2007



Specimen Preparation : Tested as received
 Test Location : Tested between dimples
 Tested Thickness : N/A
 Durometer Type : Zwick Digital 7206.07 (Shore D S/N 110129)
 Indentation Time Interval : 1.0 Second
 Indenter Used : "D"
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Set 3		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID	1	2	3	4	5				
1	53.5	51.7	51.7	52.1	52.7	52.3	0.8	1.5	
2	50.5	51.1	51.3	50.3	50.1	50.7	0.5	1.0	
3	49.1	49.7	49.5	49.3	49.6	49.4	0.2	0.5	
4	53.1	51.3	50.9	51.9	53.9	52.2	1.3	2.4	
5	50.1	49.8	49.7	49.1	48.9	49.5	0.5	1.0	
6	48.5	49.3	48.7	50.1	49.3	49.2	0.6	1.3	
7	49.1	49.5	49.7	49.7	48.9	49.4	0.4	0.7	
8	49.7	50.1	49.3	49.5	50.1	49.7	0.4	0.7	
9	49.1	49.7	50.1	48.9	50.1	49.6	0.6	1.1	
10	50.5	50.3	49.7	49.7	50.5	50.1	0.4	0.8	
11	48.7	49.1	48.9	50.7	50.5	49.6	0.9	1.9	
12	49.5	49.7	48.9	50.2	49.1	49.5	0.5	1.0	
Overall Totals						50.1	1.2	2.4	

Set 4		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID	1	2	3	4	5				
1	58.9	59.7	59.5	61.5	62.1	60.3	1.4	2.3	
2	59.7	59.9	59.7	58.9	59.3	59.5	0.4	0.7	
3	61.3	59.7	59.1	61.3	61.7	60.6	1.1	1.9	
4	60.1	61.3	59.7	60.9	59.9	60.4	0.7	1.1	
5	61.1	63.3	61.3	61.5	61.9	61.8	0.9	1.4	
6	61.3	62.3	60.3	61.3	64.1	61.9	1.4	2.3	
7	59.9	62.5	61.9	63.1	63.7	62.2	1.5	2.3	
8	61.1	59.3	61.5	60.9	61.5	60.9	0.9	1.5	
9	61.7	60.1	61.7	62.7	61.5	61.5	0.9	1.5	
10	61.1	59.7	61.1	60.1	60.1	60.4	0.6	1.1	
11	60.7	60.1	63.3	59.3	59.7	60.6	1.6	2.6	
12	63.3	61.7	60.9	61.3	61.7	61.8	0.9	1.5	
Overall Totals						61.0	1.3	2.1	

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Durometer Hardness Report Page 3 of 7

Testing	: Rubber Property - Durometer Hardness
Test Method	: ASTM D2240-05 - Modified test specimen - golf ball
Project Number	: P20071713
Customer	: Acushnet Company
Attention	: Troy Lester
Analyst	: J. McCarthy
Date	: May 22, 2007



Specimen Preparation	: Tested as received
Test Location	: Tested between dimples
Tested Thickness	: N/A
Durometer Type	: Zwick Digital 7206.07 (Shore D S/N 110129)
Indentation Time Interval	: 1.0 Second
Indenter Used	: "D"
Conditioning	: 40+ hours at 23°C ± 2°C / 50% ± 5% RH
Test Conditions	: 23°C ± 2°C / 50% ± 5% RH
Significance	: Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Set 5		Reading							
	1	2	3	4	5	Average	Std. Dev.	C.O.V. (%)	
Golf Ball ID									
1	52.3	52.5	52.9	52.5	53.1	52.7	0.3	0.8	
2	56.9	57.7	57.7	57.1	57.3	57.3	0.4	0.6	
3	53.3	53.7	57.5	54.3	52.7	54.3	1.9	3.5	
4	54.5	55.1	54.9	56.7	55.9	55.4	0.9	1.6	
5	54.7	56.3	56.1	57.7	56.5	56.3	1.1	1.9	
6	56.7	56.1	56.3	56.9	56.9	56.6	0.4	0.6	
7	54.9	52.7	52.9	54.7	52.7	53.6	1.1	2.1	
8	57.1	56.9	56.9	54.7	55.9	56.3	1.0	1.8	
9	55.5	55.3	56.7	54.9	55.7	55.6	0.7	1.2	
10	55.9	56.1	57.3	55.7	57.3	56.5	0.8	1.4	
11	55.9	56.3	56.1	56.1	56.9	56.3	0.4	0.7	
12	56.1	56.7	56.5	56.1	55.9	56.3	0.3	0.6	
Overall Totals						55.6	1.6	2.8	

Set 6		Reading							
	1	2	3	4	5	Average	Std. Dev.	C.O.V. (%)	
Golf Ball ID									
1	50.3	49.3	50.1	51.3	51.5	50.5	0.9	1.8	
2	51.0	51.5	50.7	48.7	49.1	50.2	1.2	2.4	
3	49.7	51.1	49.5	49.1	50.3	49.9	0.8	1.6	
4	51.3	49.9	49.7	50.1	50.7	50.3	0.7	1.3	
5	48.1	49.9	49.9	48.1	50.7	49.3	1.2	2.4	
6	48.3	48.7	49.1	50.5	48.9	49.1	0.8	1.7	
7	49.1	49.5	49.5	50.1	49.9	49.6	0.4	0.8	
8	50.5	50.1	49.3	49.5	49.3	49.7	0.5	1.1	
9	49.5	48.9	49.5	50.3	49.9	49.6	0.5	1.1	
10	48.5	48.5	48.5	46.5	46.5	47.7	1.1	2.3	
11	49.5	49.5	51.3	49.7	49.7	49.9	0.8	1.5	
12	51.1	50.9	48.1	48.7	49.3	49.6	1.3	2.7	
Overall Totals						49.6	1.1	2.2	

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Durometer Hardness Report Page 4 of 7

Testing : Rubber Property - Durometer Hardness
 Test Method : ASTM D2240-05 - Modified test specimen - golf ball
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : J. McCarthy
 Date : May 22, 2007



Specimen Preparation : Tested as received
 Test Location : Tested between dimples
 Tested Thickness : N/A
 Durometer Type : Zwick Digital 7206.07 (Shore D S/N 110129)
 Indentation Time Interval : 1.0 Second
 Indenter Used : "D"
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Set 7		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID	1	2	3	4	5				
1	59.3	59.3	62.3	62.1	63.1	61.2	1.8	2.9	
2	60.3	60.3	59.5	61.1	58.9	60.0	0.8	1.4	
3	56.1	57.1	56.9	58.9	57.5	57.3	1.0	1.8	
4	61.5	60.9	62.3	60.3	60.5	61.1	0.8	1.3	
5	56.7	55.5	55.5	55.9	57.9	56.3	1.0	1.8	
6	60.7	60.7	60.9	59.5	59.1	60.2	0.8	1.4	
7	59.5	60.3	59.9	60.7	59.7	60.0	0.5	0.8	
8	60.3	60.5	60.1	60.7	59.5	60.2	0.5	0.8	
9	58.3	57.9	58.5	58.5	57.9	58.2	0.3	0.5	
10	58.9	61.3	62.5	61.5	60.5	60.9	1.3	2.2	
11	60.3	59.3	57.7	58.5	58.7	58.9	1.0	1.6	
12	59.3	60.5	60.1	58.3	58.9	59.4	0.9	1.5	
Overall Totals						59.5	1.7	2.9	

Set 8		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID	1	2	3	4	5				
1	58.1	56.7	55.5	55.9	56.1	56.5	1.0	1.8	
2	56.7	58.3	56.9	57.3	55.3	56.7	1.2	2.1	
3	57.1	53.9	58.7	54.7	58.1	56.5	2.1	3.7	
4	56.9	57.3	58.1	58.3	58.9	57.9	0.8	1.4	
5	54.9	55.3	55.5	58.3	56.9	56.2	1.4	2.5	
6	56.3	54.3	53.9	53.9	54.9	54.7	1.0	1.8	
7	58.1	56.7	56.9	55.1	58.5	57.1	1.3	2.3	
8	58.3	56.1	57.1	55.9	55.3	56.5	1.2	2.1	
9	58.1	57.3	57.5	59.1	57.5	57.9	0.7	1.3	
10	56.5	57.3	59.5	56.5	56.7	57.3	1.3	2.2	
11	53.9	54.3	54.9	54.1	55.3	54.5	0.6	1.1	
12	55.2	56.1	55.3	54.5	55.5	55.3	0.6	1.0	
Overall Totals						56.4	1.5	2.7	

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Durometer Hardness Report Page 5 of 7

Testing : Rubber Property - Durometer Hardness
 Test Method : ASTM D2240-05 - Modified test specimen - golf ball
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : J. McCarthy
 Date : May 22, 2007



Specimen Preparation : Tested as received
 Test Location : Tested between dimples
 Tested Thickness : N/A
 Durometer Type : Zwick Digital 7206.07 (Shore D S/N 110129)
 Indentation Time Interval : 1.0 Second
 Indenter Used : "D"
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Set 9		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID		1	2	3	4	5			
1		48.5	49.3	50.1	49.5	48.7	49.2	0.6	1.3
2		47.5	46.9	47.7	47.9	46.1	47.2	0.7	1.5
3		46.5	46.9	49.1	46.7	47.9	47.4	1.1	2.3
4		47.7	47.5	47.1	50.1	49.5	48.4	1.3	2.8
5		47.9	50.3	48.5	48.7	48.7	48.8	0.9	1.8
6		49.3	49.3	49.9	49.5	50.3	49.7	0.4	0.9
7		48.9	49.3	49.1	49.3	47.9	48.9	0.6	1.2
8		49.1	48.9	47.9	50.1	47.9	48.8	0.9	1.9
9		47.1	44.7	44.5	44.7	45.7	45.3	1.1	2.4
10		48.1	47.1	46.1	48.5	46.7	47.3	1.0	2.1
11		47.1	47.3	48.5	47.9	47.7	47.7	0.5	1.1
12		45.9	46.3	46.5	45.3	47.3	46.3	0.7	1.6
Overall Totals							47.9	1.5	3.1

Set 10		Reading					Average	Std. Dev.	C.O.V. (%)
Golf Ball ID		1	2	3	4	5			
1		58.1	58.5	59.5	60.7	59.5	59.3	1.0	1.7
2		61.5	62.3	60.9	61.9	61.3	61.6	0.5	0.9
3		59.1	58.5	60.7	58.3	58.7	59.1	1.0	1.6
4		57.3	59.5	56.7	57.7	57.5	57.7	1.1	1.8
5		58.1	63.1	57.7	59.7	58.3	59.4	2.2	3.7
6		56.7	56.9	57.3	57.9	56.9	57.1	0.5	0.8
7		58.9	59.3	60.3	58.9	60.5	59.6	0.8	1.3
8		57.3	59.9	56.7	59.3	62.1	59.1	2.2	3.7
9		59.5	57.9	58.1	61.7	57.3	58.9	1.8	3.0
10		60.9	61.1	59.9	61.3	59.7	60.6	0.7	1.2
11		61.1	60.7	61.3	60.3	60.3	60.7	0.5	0.8
12		60.5	58.5	60.3	61.1	60.1	60.1	1.0	1.6
Overall Totals							59.4	1.6	2.8

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Durometer Hardness Report Page 6 of 7

Testing : Rubber Property - Durometer Hardness
 Test Method : ASTM D2240-05 - Modified test specimen - golf ball
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : J. McCarthy
 Date : May 22, 2007



Specimen Preparation : Tested as received
 Test Location : Tested between dimples
 Tested Thickness : N/A
 Durometer Type : Zwick Digital 7206.07 (Shore D S/N 110129)
 Indentation Time Interval : 1.0 Second
 Indenter Used : "D"
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Set 11		Reading					Average	Std. Dev.	C.O.V. (%)
		1	2	3	4	5			
Golf Ball ID									
1		55.5	54.3	58.5	56.5	55.5	56.1	1.6	2.8
2		55.3	54.9	55.5	54.3	55.1	55.0	0.5	0.8
3		56.9	58.1	56.9	57.1	56.5	57.1	0.6	1.1
4		56.5	56.7	55.9	56.3	55.7	56.2	0.4	0.7
5		55.9	56.1	55.9	56.3	56.1	56.1	0.2	0.3
6		58.5	57.7	57.1	58.3	58.1	57.5	0.9	1.5
7		59.3	60.7	59.1	58.5	58.5	59.2	0.9	1.5
8		57.5	56.5	56.1	58.5	58.1	57.3	1.0	1.8
9		56.9	56.1	57.1	56.5	56.5	56.4	0.6	1.1
10		56.5	55.7	56.5	57.5	58.3	56.9	1.0	1.8
11		57.3	58.1	58.5	56.9	56.7	57.5	0.8	1.3
12		55.9	56.1	56.7	56.5	55.5	56.1	0.5	0.9
Overall Totals							56.8	1.3	2.2

Set 12		Reading					Average	Std. Dev.	C.O.V. (%)
		1	2	3	4	5			
Golf Ball ID									
1		48.9	49.3	49.5	52.3	51.1	50.2	1.4	2.9
2		49.9	51.5	51.3	51.1	52.3	51.2	0.9	1.7
3		49.3	53.3	52.1	50.1	49.5	50.9	1.8	3.5
4		48.7	47.9	50.3	51.5	52.7	50.2	2.0	3.9
5		49.9	51.9	52.9	52.3	50.3	51.5	1.3	2.5
6		48.9	51.0	49.3	51.5	51.3	50.4	1.2	2.4
7		52.1	50.1	49.5	51.9	50.5	50.8	1.1	2.2
8		53.5	52.9	52.1	52.5	52.5	52.7	0.5	1.0
9		51.9	53.5	51.9	51.1	52.7	52.2	0.9	1.7
10		51.3	52.9	52.5	51.3	52.3	52.1	0.7	1.4
11		51.9	51.1	49.1	50.3	53.5	51.2	1.7	3.2
12		51.1	50.9	51.1	50.1	50.3	50.7	0.5	0.9
Overall Totals							51.2	1.4	2.7

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Durometer Hardness Report Page 7 of 7

Testing	: Rubber Property - Durometer Hardness
Test Method	: ASTM D2240-05 - Modified test specimen - golf ball
Project Number	: P20071713
Customer	: Acushnet Company
Attention	: Troy Lester
Analyst	: J. McCarthy
Date	: May 22, 2007


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 Cert. No. 0619.01

Specimen Preparation	: Tested as received
Test Location	: Tested between dimples
Tested Thickness	: N/A
Durometer Type	: Zwick Digital 7206.07 (Shore D S/N 110129)
Indentation Time Interval	: 1.0 Second
Indenter Used	: "D"
Conditioning	: 40+ hours at 23°C ± 2°C / 50% ± 5% RH
Test Conditions	: 23°C ± 2°C / 50% ± 5% RH
Significance	: Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Wilson Ultra Tour Balata 90 Box 93007						Average	Std. Dev.	C.O.V. (%)
	1	2	Reading 3	4	5			
Golf Ball ID								
Sample #1	61.9	62.3	62.1	63.1	61.9	62.3	0.5	0.8
Sample #2	56.3	54.9	55.1	56.1	56.3	55.7	0.7	1.2
1	55.1	56.1	56.9	57.3	55.5	56.2	0.9	1.6
3-1	62.1	62.1	60.1	60.7	61.7	61.3	0.9	1.5
3-2	61.7	61.7	62.7	61.7	62.1	62.0	0.4	0.7
3-3	60.7	62.3	63.3	60.7	62.5	61.9	1.2	1.9
Overall Totals						59.9	2.9	4.9

Wilson Ultra Tour Balata 90 - New Box						Average	Std. Dev.	C.O.V. (%)
	1	2	Reading 3	4	5			
Golf Ball ID								
2-1	63.3	61.7	60.7	60.7	61.5	61.6	1.1	1.7
2-2	59.7	60.3	60.1	60.1	59.7	60.0	0.3	0.4
2-3	59.3	59.1	58.7	59.9	60.1	59.4	0.6	1.0
3-1	61.5	61.3	61.9	62.1	60.5	61.5	0.6	1.0
3-2	62.1	60.3	63.1	63.3	62.9	62.3	1.2	2.0
3-3	60.5	61.1	62.1	60.5	61.3	61.1	0.7	1.1
4-1	60.1	60.5	61.1	60.9	60.1	60.5	0.5	0.8
4-2	59.5	60.1	59.9	61.3	59.9	60.1	0.7	1.1
4-3	61.1	60.1	60.9	61.3	61.1	60.9	0.5	0.8
Overall Totals						60.8	1.1	1.8

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Durometer Hardness Report Page 1 of 1

Testing : Rubber Property - Durometer Hardness
 Test Method : ASTM D2240-05
 Project Number : P20071713
 Customer : Acushnet Company
 Attention : Troy Lester
 Analyst : J. McCarthy
 Date : May 22, 2007



Specimen Preparation : Tested as received - One reading per disk, five disks per sample
 Sample Plied : No
 Tested Thickness : See Below
 Sample Type : Disk
 Durometer Type : Zwick Digital 7206.07 (Shore D S/N 110129)
 Indentation Time Interval : 1.0 Second
 Indenter Used : "D"
 Conditioning : 40+ hours at 23°C ± 2°C / 50% ± 5% RH
 Test Conditions : 23°C ± 2°C / 50% ± 5% RH
 Significance : Per ASTM D2240, readings below 20 or above 90 are not considered reliable.

Sample ID	1	2	Reading 3	4	5	Average	Std. Dev.	C.O.V. (%)
MDI Prepolymer	51.9	52.1	52.1	51.9	50.1	51.6	0.9	1.7
Estonia Blend	57.3	56.3	56.3	56.7	56.1	56.5	0.5	0.8
8940	63.1	63.5	64.5	63.1	65.1	63.9	0.9	1.4
Texin Blend	39.9	40.7	38.9	38.5	39.7	39.5	0.9	2.2
Blend 2	63.5	64.1	64.9	65.9	65.3	64.7	1.0	1.5
Blend 3	64.5	64.5	64.5	64.1	64.1	64.3	0.2	0.3
Blend 4	64.1	63.3	65.5	64.1	64.9	64.4	0.8	1.3
Overall Totals						57.9	9.0	15.5

Thickness (in)

MDI Prepolymer	0.349
Estonia Blend	0.259
8940	0.259
Texin Blend	0.259
Blend 2	0.260
Blend 3	0.261
Blend 4	0.249

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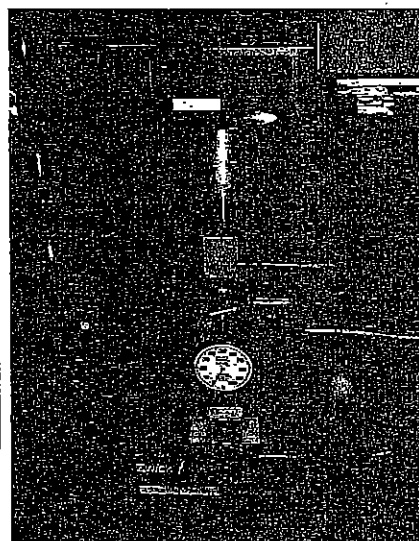
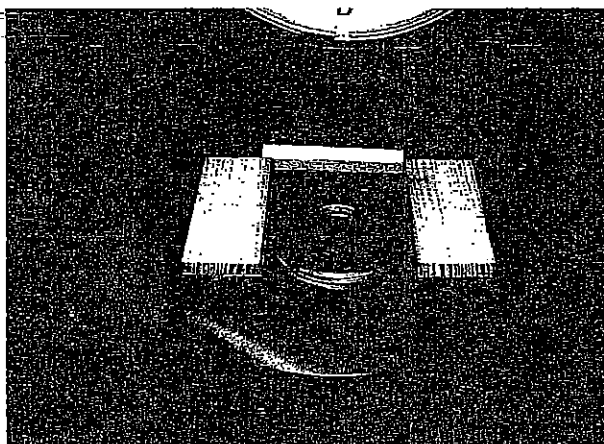
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Photos Report Page 1 of 1

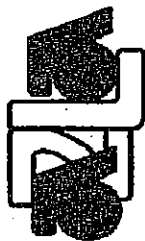
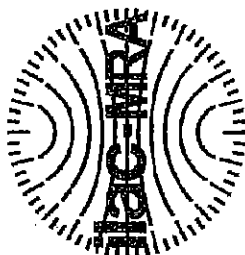
Testing : Rubber Property - Durometer Hardness
Test Method : ASTM D2240-05
Project Number : P2D071713
Customer : Acushnet Company
Attention : Troy Lester
Analyst : J. McCarthy
Date : May 22, 2007



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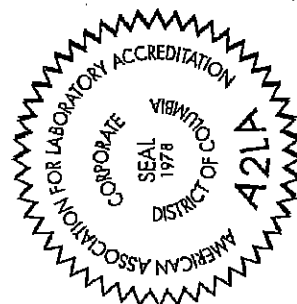
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Pittsfield, MA

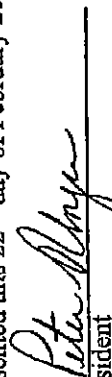
for technical competence in the field of

Mechanical Testing

This laboratory is Accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This Accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to *joint ISO-ILAC-IAF Communiqué dated 18 June 2005*).

Presented this 22nd day of February 2007.





President
For the Accreditation Council
Certificate Number 619.01
Valid to February 28, 2009

For the tests or types of tests to which this Accreditation applies,
please refer to the laboratory's Mechanical Scope of Accreditation.

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SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

PLASTICS TECHNOLOGY LABORATORIES, INC.

50 Pearl Street
Pittsfield, MA 01201
James Koehler Phone: 413 499 0983
Web address: www.ptli.com

MECHANICAL

Valid To: February 28, 2009

Certificate Number: 0619-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests on plastics and polymers, rubber and rubber products, composites, films, packaging:

Test Standard	Test Description
ASTM D149	<i>Dielectric Strength, Dielectric Breakdown:</i> Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D150	<i>Dielectric Constant, Dissipation Factor, Loss Factor, Dc/Df:</i> Standard Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation
ASTM D256	<i>Notched Izod Impact:</i> Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D257	<i>Volume / Surface Resistivity:</i> Standard Test Methods for DC Resistance or Conductance of Insulating Materials
ASTM D395	<i>Compression Set:</i> Standard Test Methods for Rubber Property—Compression Set Method B
ASTM D412	<i>Tensile Strength Of Rubber, Elastomer Tensile:</i> Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D471	<i>Volume Change, Fluid Resistance, Swell:</i> Standard Test Method for Rubber Property-Effect of Liquids
ASTM D523	<i>60° Gloss, 60 Degree Gloss, Sheen:</i> Standard Test Method for Specular Gloss
ASTM D542	<i>Refractive Index:</i> Standard Test Method for Index of Refraction of Transparent Organic Plastics
ASTM D543	<i>Chemical Compatibility:</i> Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D570	<i>Water Absorption, 24 Hour H₂O Absorption:</i> Standard Test Method for Water Absorption of Plastics
ASTM D573	<i>Oven Aging:</i> Standard Test Method for Rubber-Deterioration in an Air Oven
ASTM D618	<i>Conditioning of Plastics:</i> Standard Practice for Conditioning Plastics for Testing

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(A2LA Cert. No. 0619.01) 3/2/2007

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Test Standard	Test Description
ASTM D624	<i>Tear Strength, Die C Tear:</i> Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D635	<i>Flammability, Horizontal Burn:</i> Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D638	<i>Tensile Test of Plastics, ASTM Tensile Properties, Tensile Modulus, Elongation, Tensile Strength:</i> Standard Test Method for Tensile Properties of Plastics
ASTM D648	<i>Heat Deflection Temperature, HDT, DTUL, Deflection Temperature Under Load:</i> Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM D695	<i>Compression Test, Compressive Properties, Compression Strength, Compression Modulus:</i> Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D696	<i>Coefficient Of Linear Thermal Expansion -30°C To +30°C, CTE, Dilatometer:</i> Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
ASTM D732	<i>Shear Strength, Shear Strength By Puncture:</i> Standard Test Method for Shear Strength of Plastics by Punch Tool
ASTM D785	<i>Rockwell Hardness (M, R, E Scales):</i> Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
ASTM D789	<i>Relative Viscosity, Nylon:</i> Standard Test Methods for Determination of Relative Viscosity of Polyamide (PA)
ASTM D790	<i>Flexural Test, Three Point Bending, Four Point Bending:</i> Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D792	<i>Specific Gravity, Relative Density, Density, Apparent Density:</i> Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D882	<i>Tensile Test - Thin Sheeting, Film Tensile, Film Modulus:</i> Standard Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM D903	<i>Peel Strength, 180 Degree Peel:</i> Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D955	<i>Mold Shrinkage:</i> Standard Test Method of Measuring Shrinkage from Mold Dimensions of Thermoplastics, (Type A & B)
ASTM D1002	<i>Lap Shear, Bond Strength:</i> Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
ASTM D1003	<i>Haze and Luminous Transmittance, Diffuse Transmittance:</i> Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
ASTM D1004	<i>Tear Resistance, Film Tear:</i> Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting

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Test Standard	Test Description
ASTM D1204	<i>Dimensional Stability, Linear Dimensional Stability:</i> Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature
ASTM D1238	<i>Melt Flow Rate, MFR, Melt Index, MI:</i> Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1243	<i>Dilute Solution Viscosity:</i> Standard Test Method for Dilute Solution Viscosity of Vinyl Chloride Polymers
ASTM D1525	<i>Vicat Softening Temperature, VST:</i> Standard Test Method for Vicat Softening Temperature of Plastics
ASTM D1603	<i>Carbon Black Content:</i> Standard Test Method for Carbon Black in Olefin Plastics
ASTM D1622	<i>Apparent Density:</i> Standard Test Method for Apparent Density of Rigid Cellular Plastics
ASTM D1693	<i>Stress-Cracking, ESCR Of Polyethylene:</i> Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D1708	<i>Tensile Test, Micro Tensile:</i> Standard Test Method for Tensile Properties of Plastics By Use of Microtensile Specimens
ASTM D1709	<i>Drop-Dart Test, Film Impact, Film Dart Drop:</i> Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method
ASTM D1822	<i>Tensile Impact:</i> Standard Test Method for Tensile-Impact Energy to Break Plastics and Electrical Insulating Materials
ASTM D1894	<i>Coefficient of Friction, COF, Static COF, Kinetic COF:</i> Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheet
ASTM D1922	<i>Tear Resistance, Elmendorf Tear:</i> Standard Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheet by Pendulum Method
ASTM D1938	<i>Trouser Tear:</i> Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheet by a Single-Tear Method
ASTM D2240	<i>Durometer Hardness (A & D), Shore Hardness, Shore Durometer:</i> Standard Test Method for Rubber Property—Durometer Hardness
ASTM D2244	<i>Color, CIE Hunter:</i> Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2344	<i>Short Beam Shear, Interlaminar Shear:</i> Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D2565	<i>Xenon Arc Accelerated Weathering, Artificial Weathering:</i> Standard Practice for Xenon Arc Exposure of Plastics Intended for Outdoor Applications
ASTM D2583	<i>Barcol Hardness, Indenter Hardness:</i> Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D2584	<i>Ignition Loss, Glass Content, Fiber Content, Ash Content, Resin Content:</i> Standard Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D2734	<i>Void Content, Method A:</i> Standard Test Methods for Void Content of Reinforced Plastics

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Test Standard	Test Description
ASTM D2857	<i>Viscosity, Dilute Solution Viscosity, Intrinsic Viscosity, Inherent Viscosity:</i> Standard Practice for Dilute Solution Viscosity of Polymers
ASTM D2863	<i>Oxygen Index, OI, Limiting Oxygen Index, LOI:</i> Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM D3163	<i>Lap-Shear, Bond Strength:</i> Standard Test Method for Determining Strength of Adhesively Bonded Rigid Plastic Lap-Shear Joints in Shear by Tension Loading
ASTM D3167	<i>Peel Test, Floating Roller Peel:</i> Standard Test Method for Floating Roller Peel Resistance of Adhesives
ASTM D3170	<i>Chip Resistance, Gravelometer:</i> Standard Test Method for Chipping Resistance of Coatings
ASTM D3171	<i>Acid Digestion, Void Content By Acid Digestion:</i> Standard Test Methods for Constituent Content of Composite Materials, Procedures A, B, C, D, E, G
ASTM D3359	<i>Cross Hatch Adhesion:</i> Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D3418	<i>Tg, Glass Transition Temperature by DSC:</i> Standard Test Method for Transition Temperatures of Polymers By Differential Scanning Calorimetry
ASTM D3574-A	<i>Density:</i> Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
ASTM D3574-E	<i>Tensile Properties:</i> Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
ASTM D3574-F	<i>Tear Resistance:</i> Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
ASTM D3763	<i>Dynatup, Instrumented Impact:</i> Standard Test Method for High Speed Puncture Properties of Plastics Using Load and Displacement Sensors
ASTM D3801	<i>Flammability, Vertical Burn:</i> Standard Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position
ASTM D3835	<i>Capillary Rheometry, Melt Viscosity, Thermal Stability, Apparent Viscosity:</i> Standard Test Method for Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer
ASTM D4060	<i>Taber Abrasion:</i> Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4226	<i>Impact Resistance, Gardner Impact, Drop Dart Impact:</i> Standard Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products
ASTM D4329	<i>UV Exposure, QUV Exposure:</i> Standard Practice for Fluorescent UV Exposure of Plastics
ASTM D4440	<i>Dynamic Mechanical Analysis, DMA, Parallel Plate Rheology, Steady State Shear:</i> Standard Test Method for Plastics: Dynamic Mechanical Properties: Melt Rheology
ASTM D4459	<i>Xenon-Arc, Indoor Accelerated Sunlight Exposure:</i> Standard Practice for Xenon-Arc Exposure of Plastics Intended for Indoor Applications

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Test Standard	Test Description
ASTM D4587	<i>UV Exposure, QUV:</i> Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D4812	<i>Unnotched Impact, Unnotched Izod:</i> Standard Test Method for Unnotched Cantilever Beam Impact Strength of Plastics
ASTM D5048-B	<i>Burning Characteristics and Resistance to Burn Through of Solid Plastics:</i> Standard Test Method for Measuring the Comparative Burning Characteristics and Resistance to Burn-Through of Solid Plastics Using 125-mm Flame
ASTM D5132	<i>Horizontal Burn Rate:</i> Standard Test Method for Horizontal Burning Rate of Polymeric Materials Used in Occupant Compartments of Motor Vehicles
ASTM D5279	<i>DMA in Torsion, Shear Modulus, Storage Modulus, Tan Delta, Tg:</i> Standard Test Method for Plastics: Dynamic Mechanical Properties: In Torsion
ASTM D5379	<i>Shear of Composite, V-Notch Shear, Iosipescu Shear:</i> Standard Test Method for Shear Properties of Composite Materials by the V-Notched Beam Method
ASTM D5420	<i>Impact Resistance, Gardner Impact, Drop Dart Impact:</i> Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
ASTM D5628	<i>Impact Resistance, Gardner Impact, Drop Dart Impact:</i> Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimens by Means of a Falling Dart (Tup or Falling Mass)
ASTM D5630	<i>Ash Content:</i> Standard Test Method for Ash Content in Thermoplastics
ASTM D6110	<i>Charpy Impact of Notched Samples:</i> Standard Test Method for Determining the Charpy Impact Resistance of Notched Specimens of Plastics
ASTM D6272	<i>Flexural Property, Four Point Flex, Four Point Bending:</i> Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials by Four-Point Bending
ASTM D6290	<i>Color Analysis:</i> Standard Test Method for Color Determination of Plastic Pellets
ASTM D6869	<i>Karl Fischer, Water Content, Moisture Content By Karl Fischer Titration:</i> Standard Test Method for Coulometric and Volumetric Determination of Moisture in Plastics Using the Karl Fischer Reaction (the Reaction of Iodine with Water)
ASTM E96	<i>Water Vapor Transmission, WVTR:</i> Standard Test Methods for Water Vapor Transmission of Materials
ASTM E313	<i>Yellowness Index:</i> Standard Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates
ASTM E793	<i>DSC, Delta H, Heat of Fusion, Crystallinity:</i> Standard Test Method for Enthalpies of Fusion and Crystallization by Differential Scanning Calorimetry
ASTM E831	<i>TMA, CTE, Coefficient Of Thermal Expansion, Tg By TMA:</i> Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis
ASTM E1131	<i>TGA, Carbon Black Content By TGA, Ash Content:</i> Standard Test Method for Compositional Analysis by Thermogravimetry

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Test Standard	Test Description
ASTM E1252	<i>FTIR, Material ID, Basic Material Identification</i> : Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis
ASTM E1269	<i>DSC, Specific Heat</i> : Standard Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry
ASTM E1347	<i>Color Analysis, Tristimulus Color</i> : Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry
ASTM E1356	<i>DSC, Tg, Glass Transition Temperature By DSC</i> : Standard Test Method for Assignment of the Glass Transition Temperatures by Differential Scanning Calorimetry
ASTM E1545	<i>TMA, Tg By TMA, Glass Transition Temperature By TMA</i> : Standard Test Method for Assignment of the Glass Transition Temperature by Thermomechanical Analysis
ASTM E1868	<i>LOD By TGA, Weight Loss</i> : Standard Test Method for Loss-On-Drying by Thermogravimetry
ASTM F1306	<i>Slow Rate Penetration</i> : Standard Test Method for Slow Rate Penetration Resistance of Flexible Barrier Films and Laminates
ASTM G151	<i>QUV UV Exposure</i> : Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
ASTM G154	<i>QUV: UV Exposure</i> : Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
ASTM G155	<i>Xenon Arc, Accelerated Weathering</i> : Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
ISO 34-1	<i>Tear Strength</i> : Rubber, Vulcanized or Thermoplastic -- Determination of Tear Strength -- Part 1: Method B Using an Angle Test Piece With or Without a Nick of Specified Depth
ISO 37	<i>Tensile Strength</i> : Rubber, Vulcanized or Thermoplastic -- Determination of Tensile Stress-Strain Properties
ISO 62	<i>Water Absorption, H₂O Absorption</i> : Plastics -- Determination of Water Absorption
ISO 75	<i>Heat Deflection Temperature, HDT</i> : Plastics -- Determination of Temperature of Deflection Under
ISO 178	<i>Flexural Properties, Flexural Stress, Flexural Modulus</i> : Determination of Flexural Properties
ISO 179-1	<i>Charpy Impact Strength</i> : Plastics -- Determination of Charpy Impact Properties -- Part 1: Non-Instrumented Impact Test
ISO 180	<i>Izod Impact</i> : Plastics -- Determination of Izod Impact Strength
ISO 188	<i>Accelerated Aging in an Oven</i> : Rubber, vulcanized or thermoplastic -- Accelerated ageing and heat resistance tests
ISO 291	<i>Conditioning of Plastics</i> : Plastics -- Standard Atmospheres for Conditioning and Testing
ISO 306	<i>Vicat Softening Temperature, VST</i> : Plastics -- Thermoplastic Materials -- Determination of Vicat Softening Temperature (VST)

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Test Standard	Test Description
ISO 489	<i>Refractive Index, RI, Index of Refraction:</i> Plastics -- Determination of Refractive Index
ISO 527	<i>Tensile Properties, Tensile Modulus, Tensile Strength:</i> Plastics -- Determination of Tensile
ISO 604	<i>Compression Properties, Compressive Strength, Compressive Modulus:</i> Plastics -- Determination of Compressive Properties
ISO 815	<i>Compression Set:</i> Rubber, Vulcanized or Thermoplastic -- Determination of Compression Set At Ambient, Elevated or Low Temperatures
ISO 868	<i>Hardness, Shore A & D:</i> Plastics and Ebonite -- Determination of Indentation Hardness by Means of A Durometer (Shore Hardness)
ISO 1133	<i>Melt Flow Rate, Melt Volume Rate:</i> Plastics -- Determination of The Melt Mass-Flow Rate (MFR) and The Melt Volume-Flow Rate (MVR) of Thermoplastics
ISO 1183-1	<i>Density, Specific Gravity:</i> Plastics -- Methods for Determining The Density of Non-Cellular Plastics -- Part 1: Method A Immersion Method
ISO 1817	<i>Volume Swell:</i> Rubber, Vulcanized -- Determination of The Effect of Liquids
ISO 2039-2	<i>Hardness, Rockwell:</i> Plastics -- Determination of Hardness -- Part 2: Rockwell Hardness (M, R, E Scales)
ISO 3451	<i>Ash Content, Percent Ash:</i> Plastics -- Determination of Ash
ISO 3795	<i>Flammability:</i> Road Vehicles, and Tractors and Machinery for Agriculture and Forestry -- Determination of Burning Behaviour of Interior Materials
ISO 4589-2	<i>Oxygen Index:</i> Plastics -- Determination of Burning Behaviour by Oxygen Index Part 2: Ambient-Temperature Test
ISO 4892-3	<i>QUV, UV Exposure:</i> Plastics -- Methods of Exposure To Laboratory Light Sources -- Part 3: Fluorescent UV Lamps
ISO 6383-2	<i>Tear Resistance of Film:</i> Determination of tear resistance -- Part 2: Elmendorf method
ISO 6452	<i>Fogging:</i> Rubber or Plastics Coated Fabrics -- Determination of Fogging Characteristics of Trim Materials In The Interior Of Automobiles
ISO 6603-2	<i>Dynatup, Multiaxial Impact:</i> Plastics -- Determination of Puncture Impact Behaviour of Rigid Plastics -- Part 2: Instrumented Impact Testing
ISO 7765	<i>Drop Dart, Dynatup:</i> Plastics Film and Sheeting -- Determination of Impact Resistance by The Free-Falling Dart Method -- Part 1: Staircase Methods; Part 2: Instrumented Puncture Test
ISO 8009-9	<i>Tensile Properties of Contraceptives:</i> Mechanical contraceptives -- Reusable natural and silicone rubber contraceptive diaphragms -- Section 9 of requirements and tests
ISO 11357	<i>DSC, Glass Transition Temperature, Tg, Crystallinity, Delta H, Heat of Fusion:</i> Plastics -- Differential Scanning Calorimetry (DSC)
ISO 11358	<i>TGA, Change In Mass, Thermal Residue:</i> Plastics -- Thermogravimetry (TG) of Polymers -- General Principles

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Test Standard	Test Description
ISO 11359	<i>TMA, CTE, Coefficient of Thermal Expansion, Glass Transition Temperature by TMA, Tg by TMA, Penetration Temperature by TMA: Plastics – Thermomechanical Analysis (TMA)</i>
ISO 11443	<i>Shear Viscosity: Plastics – Determination of The Fluidity of Plastics Using Capillary and Slit-Die Rheometers</i>
ISO 15512	<i>Karl Fischer, Water Content, Moisture Content By Karl Fischer Titration: Plastics – Determination of Water Content Method B Water Vaporization</i>

Test Standards Other Than ASTM And ISO Methods

49 CFR 571.302	<i>Flammability: Code of Federal Regulations Title 49: Transportation CFR Part 571 Federal Motor Vehicle Standards Section 302 Flammability of Interior Materials Also Identified As FMVSS 302</i>
DIN 75 201	<i>Fogging: Determination of the Windscreen Fogging Characteristics of Trim Materials in Motor Vehicles</i>
EIA 564	<i>Polycarbonate Chemical Compatibility</i>
GM9059P	<i>Thermal Oxidative Stability: Test for Thermal-Oxidative Stability Characteristics of Plastics</i>
GM9305P	<i>Fogging: Criteria for Determining Acceptable/Nonacceptable Materials</i>
GM9900P	<i>Solvent Resistance, Chemical Compatibility: Cleaning/Solvent Resistance of Automotive Components During Normal Customer Use</i>
IEC 60093	<i>Volume and Surface Resistivity: Methods of Test for Volume Resistivity and Surface Resistivity of Solid Electrical Insulating Materials</i>
IEC 60243	<i>Dielectric Strength: Electrical Strength of Insulating Materials – Test Methods – Part 1: Tests at Power Frequencies</i>
IEC 60250	<i>Dielectric Constant, Dissipation Factor, Loss Factor: Recommended Methods for The Determination of The Permittivity and Dielectric Dissipation Factor of Electrical Insulating Materials At Power, Audio and Radio Frequencies Including Metre Wavelengths</i>
MIL-STD-3010A	<i>Test Method 2065 Puncture Resistance: <u>Supercedes Canceled Document</u> - FTMS 101C-2065.1 Puncture Resistance and Elongation Test (1/8 Inch Radius Probe Method)</i>
SAE J369	<i>Horizontal Flame Test: Flammability of Polymeric Interior Materials–Horizontal Test Method</i>
SAE J400	<i>Chip Resistance, Gravelometer: Test for Chip Resistance of Surface Coatings</i>
SAE J1756	<i>Fogging: Test Procedure To Determine The Fogging Characteristics of Interior Automotive Materials</i>
SAE J1885	<i>Xenon Arc Accelerated Weathering, Artificial Weathering: Accelerated Exposure of Automotive Interior Trim Components Using A Controlled Irradiance Water Cooled Xenon-Arc Apparatus</i>

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Test Standard	Test Description
SAE J1960	<i>Xenon Arc Accelerated Weathering, Artificial Weathering:</i> Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Water-Cooled Xenon Arc Apparatus
SAE J2020	<i>QUV:</i> Accelerated Exposure of Automotive Exterior Materials Using a Fluorescent UV and Condensation Apparatus
SAE J2236	<i>Temperature Resistance:</i> Standard Method for Determining Continuous Upper Temperature Resistance of Elastomers
UL-94	<i>Flammability:</i> Tests For Flammability of Plastic Materials for Parts in Devices and Appliances

EXHIBIT 30

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(54) Improved multi-layer golf ball

(57) An improved multi-layer golf ball comprises a core, an inner cover layer and an outer cover layer. The inner cover layer is comprised of a high acid ionomer or ionomer blend which may or may not include a filler such as zinc-stearate. The outer cover layer is comprised of a soft, very low modulus ionomer or ionomer blend, or a non-ionomeric thermoplastic elastomer such as polyurethane, polyester or polyestaramide. The resulting multi-layered golf ball of the present invention provides for enhanced distance without sacrificing playability or durability when compared to known multi-layer golf balls.

GB 2 278 609 A

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1990.

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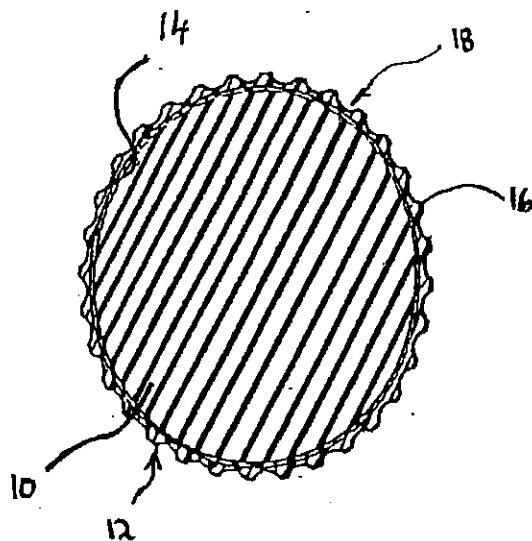


FIG. 1

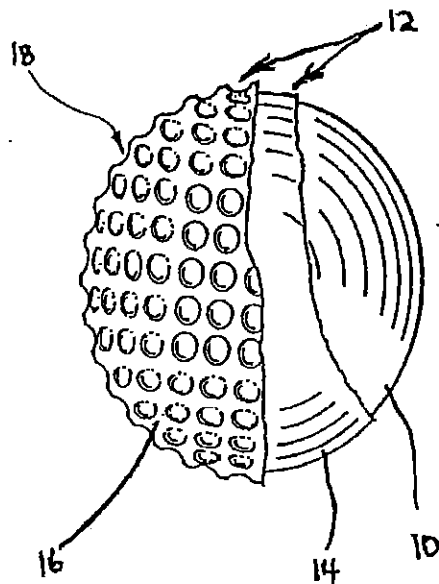


FIG. 2

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IMPROVED MULTI-LAYER GOLF BALL

The present invention relates to golf balls and, more particularly, to improved golf balls comprising multi-layer covers which have a hard inner layer and a relatively soft outer layer. The improved multi-layer golf balls provide for enhanced distance and durability properties while at the same time offering the "feel" and spin characteristics associated with soft balata and balata-like covers of the prior art.

Traditional golf ball covers have been comprised of balata or blends of balata with elastomeric or plastic materials. The traditional balata covers are relatively soft and flexible. Upon impact, the soft balata covers compress against the surface of the club producing high spin. Consequently, the soft and flexible balata covers provide an experienced golfer with the ability to apply a spin to control the ball in flight in order to produce a draw or a fade, or a backspin which causes the ball to "bite" or stop abruptly on contact with the green. Moreover, the soft balata covers produce a soft "feel" to the low handicap player. Such

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playability properties (workability, feel, etc.) are particularly important in short iron play with low swing speeds and are exploited significantly by relatively skilled players.

Despite all the benefits of balata, balata covered golf balls are easily cut and/or damaged if mis-hit. Golf balls produced with balata or balata-containing cover compositions therefore have a relatively short lifespan.

As a result of this negative property, balata and its synthetic substitutes, trans-polybutadiene and transpolyisoprene, have been essentially replaced as the cover materials of choice by new cover materials comprising ionomeric resins.

Ionomeric resins are polymers containing interchain ionic bonding. As a result of their toughness, durability and flight characteristics, various ionomeric resins sold by E. I. DuPont de Nemours & Company under the trademark "Surlyn®" and more recently, by the Exxon Corporation (see U. S. Patent No. 4,911,451) under the trademarks "Escor®" and the trade name "Iotek", have become the materials of choice for the construction of golf ball covers over the traditional "balata" (transpolyisoprene, natural or synthetic) rubbers. As stated, the softer balata covers, although exhibiting enhanced playability properties, lack the durability (cut and abrasion resistance, fatigue endurance, etc.) properties required for repetitive play.

Ionomeric resins are generally ionic copolymers of an olefin, such as ethylene, and a metal salt of an unsaturated carboxylic acid, such as acrylic acid, methacrylic acid, or maleic acid. Metal ions, such as sodium or zinc, are used to neutralize

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some portion of the acidic group in the copolymer resulting in a thermoplastic elastomer exhibiting enhanced properties; i.e. durability, etc., for golf ball cover construction over balata. However, some of the advantages gained in increased durability have been offset to some degree by the decreases produced in playability. This is because although the ionomeric resins are very durable, they tend to be very hard when utilized for golf ball cover construction, and thus lack the degree of softness required to impart the spin necessary to control the ball in flight. Since the ionomeric resins are harder than balata, the ionomeric resin covers do not compress as much against the face of the club upon impact, thereby producing less spin. In addition, the harder and more durable ionomeric resins lack the "feel" characteristic associated with the softer balata related covers.

As a result, while there are currently more than fifty (50) commercial grades of ionomers available both from DuPont and Exxon, with a wide range of properties which vary according to the type and amount of metal cations, molecular weight, composition of the base resin (i.e., relative content of ethylene and methacrylic and/or acrylic acid groups) and additive ingredients such as reinforcement agents, etc., a great deal of research continues in order to develop a golf ball cover composition exhibiting not only the improved impact resistance and carrying distance properties produced by the "hard" ionomeric resins, but also the playability (i.e., "spin", "feel", etc.) characteristics previously associated

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with the "soft" balata covers, properties which are still desired by the more skilled golfer.

Consequently, a number of two-piece (a solid resilient center or core with a molded cover) and three-piece (a liquid or solid center, elastomeric winding about the center, and a molded cover) golf balls have been produced by the present inventor and others to address these needs. The different types of materials utilized to formulate the cores, covers, etc. of these balls dramatically alters the balls' overall characteristics. In addition, multi-layered covers containing one or more ionomer resins have also been formulated in an attempt to produce a golf ball having the overall distance, playability and durability characteristics desired.

This was addressed by Spalding & Evenflo Companies, Inc.

in U. S. Patent No. 4,431,193 where a multi-layered golf ball is disclosed. In the '193 patent, a multi-layer golf ball is produced by initially molding a first cover layer on a spherical core and then adding a second layer. The first layer is comprised of a hard, high flexural modulus resinous material such as type 1605 Surlyn® (now designated Surlyn® 8940). Type 1605 Surlyn® (Surlyn® 8940) is a sodium ion based low acid (less than or equal to 15 weight percent methacrylic acid) ionomer resin having a flexural modulus of about 51,000 psi. An outer layer of a comparatively soft, low flexural modulus resinous material such as type 1855 Surlyn® (now designated Surlyn® 9020) is molded over the inner cover layer. Type 1855

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Surlyn® (Surlyn® 9020) is a zinc ion based low acid (10 weight percent methacrylic acid) ionomer resin having a flexural modulus of about 14,000 psi.

The '193 patent teaches that the hard, high flexural modulus resin which comprises the first layer provides for a gain in coefficient of restitution over the coefficient of restitution of the core. The increase in the coefficient of restitution provides a ball which serves to attain or approach the maximum initial velocity limit of 255 feet per second as provided by the United States Golf Association (U.S.G.A.) rules. The relatively soft, low flexural modulus outer layer provides essentially no gain in the coefficient of restitution but provides for the advantageous "feel" and playing characteristics of a balata covered golf ball. Unfortunately, however, while a ball of the '193 patent does exhibit enhanced playability characteristics with improved distance (i.e. enhanced C.O.R. values) over a number of other known multi-layered balls, the ball suffers from poor cut resistance and relatively short distance (i.e. lower C.O.R. values) when compared to two-piece, single cover layer balls. These undesirable properties make the ball produced in accordance with the '193 patent unacceptable by today's standards.

The present invention is directed to new multi-layer golf ball compositions which provide for enhanced coefficient of restitution (i.e. enhanced resilience or carrying distance) and/or durability properties when compared to the multi-layer balls found in the prior art, as well as improved outer cover layer softness

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and durability. As such, the playability characteristics (i.e., "feel", "click", "spin", etc.) are not diminished.

These and other objects and features of the invention will be apparent from the following summary and description of the invention, the drawings and from the claims.

The present invention is directed to improved multi-layer golf ball cover compositions and the resulting multi-layer golf balls produced using the improved compositions. The novel multi-layer golf ball covers of the present invention include a first or inner layer or ply of a high acid (greater than 16 weight percent acid) ionomer or ionomer blend and second or outer layer or ply comprised of a comparatively softer, low modulus ionomer, ionomer blend or other non-ionomeric thermoplastic elastomer such as polyurethane, a polyester elastomer such as Hytrel® polyester elastomer of E.I. DuPont de Nemours & Company, or a polyesteramide such as the Elf Atochem S.A. Pebax® polyesteramide. Preferably, the outer cover layer includes a blend of hard and soft low acid (i.e. 16 weight percent acid or less) ionomers.

It has been found that the recently developed high acid ionomer based inner layer, provides for a substantial increase in resilience (i.e., enhanced distance) over known multi-layer covered balls. The softer outer layer provides for desirable "feel" and high spin rate while maintaining respectable resiliency. The soft outer layer allows the cover to deform more during impact and increases the area of contact between the club face and the cover,

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thereby imparting more spin on the ball. As a result, the soft cover provides the ball with a balata-like feel and playability characteristics with improved distance and durability. Consequently, the overall combination of the inner and outer cover layers results in a golf ball having enhanced resilience (improved travel distance) and durability (i.e. cut resistance, etc.) characteristics while maintaining and in many instances, improving the balls playability properties.

The combination of a high acid ionomer or ionomer blend inner cover layer with a soft, relatively low modulus ionomer, ionomer blend or other non-ionomeric thermoplastic elastomer outer cover layer provides for excellent overall coefficient of restitution (i.e., excellent resilience) because of the improved resiliency produced by the inner cover layer. While some improvement in resiliency is also produced by the outer cover layer, the outer cover layer generally provides for a more desirable feel and high spin, particularly at lower swing speeds with highly lofted clubs such as half wedge shots.

Two principal properties involved in golf ball performance are resilience and hardness. Resilience is determined by the coefficient of restitution (C.O.R.), the constant "e" which is the ratio of the relative velocity of two elastic spheres after direct impact to that before impact. As a result, the coefficient of restitution ("e") can vary from 0 to 1, with 1 being equivalent to an elastic collision and 0 being equivalent to an inelastic collision.

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Resilience (C.O.R.), along with additional factors such as club head speed, angle of trajectory and ball configuration (i.e., dimple pattern) generally determine the distance a ball will travel when hit. Since club head speed and the angle of trajectory are factors not easily controllable by a manufacturer, factors of concern among manufacturers are the coefficient of restitution (C.O.R.) and the surface configuration of the ball.

The coefficient of restitution (C.O.R.) in solid core balls is a function of the composition of the molded core and of the cover. In balls containing a wound core (i.e., balls comprising a liquid or solid center, elastic windings, and a cover), the coefficient of restitution is a function of not only the composition of the center and cover, but also the composition and tension of the elastomeric windings. Although both the core and the cover contribute to the coefficient of restitution, the present invention is directed to the enhanced coefficient of restitution (and thus travel distance) which is affected by the cover composition.

In this regard, the coefficient of restitution of a golf ball is generally measured by propelling a ball at a given speed against a hard surface and measuring the ball's incoming and outgoing velocity electronically. As mentioned above, the coefficient of restitution is the ratio of the outgoing velocity to the incoming velocity. The coefficient of restitution must be carefully controlled in all commercial golf balls in order for the ball to be within the specifications regulated by the United States

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Golf Association (U.S.G.A.). Along this line, the U.S.G.A. standards indicate that a "regulation" ball cannot have an initial velocity (i.e., the speed off the club) exceeding 255 feet per second. Since the coefficient of restitution of a ball is related to the ball's initial velocity, it is highly desirable to produce a ball having sufficiently high coefficient of restitution to closely approach the U.S.G.A. limit on initial velocity, while having an ample degree of softness (i.e., hardness) to produce enhanced playability (i.e., spin, etc.).

The hardness of the ball is the second principal property involved in the performance of a golf ball. The hardness of the ball can affect the playability of the ball on striking and the sound or "click" produced. Hardness is determined by the deformation (i.e., compression) of the ball under various load conditions applied across the ball's diameter (i.e., the lower the compression value, the harder the material). As indicated in U.S. Patent No. 4,674,751, softer covers permit the accomplished golfer to impart proper spin. This is because the softer covers deform on impact significantly more than balls having "harder" ionomeric resin covers. As a result, the better player is allowed to impart fade, draw or backspin to the ball thereby enhancing playability. Such properties may be determined by various spin rate tests such as the "nine iron" spin rate test described below in the Examples.

Accordingly, the present invention is directed to an improved multi-layer cover which produces, upon molding each layer around a core (preferably a solid core) to formulate a multi-layer

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cover, a golf ball exhibiting enhanced distance (i.e., resilience) without adversely affecting, and in many instances, improving the ball's playability (hardness/softness) and/or durability (i.e., cut resistance, fatigue resistance, etc.) characteristics.

These and other objects and features of the invention will be apparent from the following detailed description and the accompanying drawings which are by way of example.

FIG. 1 is a cross-sectional view of a golf ball embodying the invention illustrating a core 10 and a cover 12 consisting of an inner layer 14 and an outer layer 16 having dimples 18; and

FIG. 2 is a diametrical cross-sectional view of a golf ball of the invention having a core 10 and a cover 12 made of an inner layer 14 and an outer layer 16 having dimples 18.

The present invention relates to improved multi-layer golf balls, particularly a golf ball comprising a multi-layered cover 12 over a solid core 10, and method for making same.

The multi-layered cover 12 comprises two layers: a first or inner layer or ply 14 and a second or outer layer or ply 16. The inner layer 14 is comprised of a high acid (i.e. greater than 16 weight percent acid) ionomer resin or high acid ionomer blend. Preferably, the inner layer is comprised of a blend of two or more high acid (i.e. at least 16 weight percent acid) ionomer resin neutralized to various extents by different metal cations. The inner cover layer may or may not include a metal stearate (e.g., zinc stearate) or other metal fatty acid salt. The purpose of the

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metal stearate or other metal fatty acid salt is to lower the cost of production without affecting the overall performance of the finished golf ball.

The inner layer compositions include the high acid ionomers such as those recently developed by E. I. DuPont de Nemours & Company under the trademark "Surllyn®" and by Exxon Corporation under the trademark "Escor®" or tradename "Totak", or blends thereof. Examples of compositions which may be used as the inner layer herein are set forth in detail in copending U. S. Serial No. 07/776,803 filed October 15, 1991, and Serial No. 07/901,660 filed June 19, 1992, both incorporated herein by reference. Of course, the inner layer high acid ionomer compositions are not limited in any way to those compositions set forth in said copending applications. For example, the high acid ionomer resins recently developed by Spalding & Evenflo Companies, Inc., the assignee of the present invention, and disclosed in U.S. Serial No. 07/901,680, filed June 19, 1992, incorporated herein by reference, may also be utilized to produce the inner layer of the multi-layer cover used in the present invention.

The high acid ionomers which may be suitable for use in formulating the inner layer compositions of the subject invention are ionic copolymers which are the metal, i.e., sodium, zinc, magnesium, etc., salts of the reaction product of an olefin having from about 2 to 8 carbon atoms and an unsaturated monocarboxylic acid having from about 3 to 8 carbon atoms. Preferably, the ionomeric resins are copolymers of ethylene and either acrylic or

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methacrylic acid. In some circumstances, an additional comonomer such as an acrylate ester (i.e., iso- or n-butylacrylate, etc.) can also be included to produce a softer terpolymer. The carboxylic acid groups of the copolymer are partially neutralized (i.e., approximately 10-75%, preferably 30-70%) by the metal ions. Each of the high acid ionomer resins which may be included in the inner layer cover compositions of the invention contains greater than about 16% by weight of a carboxylic acid, preferably from about 17% to about 25% by weight of a carboxylic acid, more preferably from about 18.5% to about 21.5 % by weight of a carboxylic acid.

Although the inner layer cover composition preferably includes a high acid ionomeric resin and the scope of the patent embraces all known high acid ionomeric resins falling within the parameters set forth above, only a relatively limited number of these high acid ionomeric resins have recently become commercially available.

The high acid ionomeric resins available from Exxon under the designation "Escor®" and or "Iotek", are somewhat similar to the high acid ionomeric resins available under the "Surlyn®" trademark. However, since the Escor®/Iotek ionomeric resins are sodium or zinc salts of poly(ethylene-acrylic acid) and the "Surlyn®" resins are zinc, sodium, magnesium, etc. salts of poly(ethylene-methacrylic acid), distinct differences in properties exist.

Examples of the high acid methacrylic acid based ionomers found suitable for use in accordance with this invention include

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Surlyn® AD-8422 (sodium cation), Surlyn® 8162 (zinc cation), Surlyn® SEP-503-1 (zinc cation), and Surlyn® SEP-503-2 (magnesium cation). According to DuPont, all of these ionomers contain from about 18.5 to about 21.5% by weight methacrylic acid.

More particularly, Surlyn® AD-8422 is currently commercially available from DuPont in a number of different grades (i.e., AD-8422-2, AD-8422-3, AD-8422-5, etc.) based upon differences in melt index. According to DuPont, Surlyn® AD-8422 offers the following general properties when compared to Surlyn®8920, the stiffest, hardest of all on the low acid grades (referred to as "hard" ionomers in U.S. Patent No. 4,884,814):

	<u>LOW ACID</u>	<u>HIGH ACID</u>	
	(15 wt% Acid)	(>20 wt% Acid)	
	SURLYN®	SURLYN®	SURLYN®
	<u>8920</u>	<u>8422-2</u>	<u>8422-3</u>
<u>IONOMER</u>			
Cation	Na	Na	Na
Melt Index	1.2	2.8	1.0
Sodium, Wt%	2.3	1.9	2.4
Base Resin MI	60	60	60
HP ¹ , °C	88	86	85
FP ¹ , °C	47	48.5	45
<u>COMPRESSION MOLDING¹</u>			
Tensile Break,			
psi	4350	4190	5330
Yield, psi	2880	1670	1590
Elongation, %	315	263	289
Flex Mod,			
K psi	53.2	76.4	88.3

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Shore D			
hardness	66	67	68

¹ DSC second heat, 10°C/min heating rate.

² Samples compression molded at 150°C annealed 24 hours at 60°C. 8422-2, -3 were homogenized at 190°C before molding.

In comparing Surlyn® 8920 to Surlyn® 8422-2 and Surlyn® 8422-3, it is noted that the high acid Surlyn® 8422-2 and 8422-3 ionomers have a higher tensile yield, lower elongation, slightly higher Shore D hardness and much higher flexural modulus. Surlyn® 8920 contains 15 weight percent methacrylic acid and is 59% neutralized with sodium.

In addition, Surlyn® SEP-503-1 (zinc cation) and Surlyn® SEP-503-2 (magnesium cation) are high acid zinc and magnesium versions of the Surlyn® AD 8422 high acid ionomers. When compared to the Surlyn® AD 8422 high acid ionomers, the Surlyn SEP-503-1 and SEP-503-2 ionomers can be defined as follows:

<u>Surlyn® Ionomer</u>	<u>Ion</u>	<u>Melt Index</u>	<u>Neutralization %</u>
AD 8422-3	Na	1.0	45
SEP 503-1	Zn	0.8	38
SEP 503-2	Mg	1.8	43

Furthermore, Surlyn® 8162 is a zinc cation ionomer resin containing approximately 20% by weight (i.e. 18.5-21.5% weight) methacrylic acid copolymer that has been 30-70% neutralized. Surlyn® 8162 is currently commercially available from DuPont.

Examples of the high acid acrylic acid based ionomers suitable for use in the present invention also include the Escor® or Iotek high acid ethylene acrylic acid ionomers produced by

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Exxon. In this regard, Escor® or Iotek 959 is a sodium ion neutralized ethylene-acrylic neutralized ethylene-acrylic acid copolymer. According to Exxon, Ioteks 959 and 960 contain from about 19.0 to about 21.0% by weight acrylic acid with approximately 30 to about 70 percent of the acid groups neutralized with sodium and zinc ions, respectively. The physical properties of these high acid acrylic acid based ionomers are as follows:

<u>PROPERTY</u>	<u>ESCORO (IOTEX) 959</u>	<u>ESCORO (IOTEX) 960</u>
Melt Index, g/10 min	2.0	1.6
Cation	Sodium	Zinc
Melting Point, °F	172	174
Vicat Softening Point, °F	130	131
Tensile B Break, psi	4600	3500
Elongation B Break, %	325	430
Hardness, Shore D	66	57
Flexural Modulus, psi	66,000	27,000

Furthermore, as a result of the development by the inventor of a number of new high acid ionomers neutralized to various extents by several different types of metal cations, such as by manganese, lithium, potassium, calcium and nickel cations, several new high acid ionomers and/or high acid ionomer blends besides sodium, zinc and magnesium high acid ionomers or ionomer blends are now available for golf ball cover production. It has been found that these new cation neutralized high acid ionomer blends produce inner cover layer compositions exhibiting enhanced hardness and resilience due to synergies which occur during

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processing. Consequently, the metal cation neutralized high acid ionomer resins recently produced can be blended to produce substantially harder inner cover layers for multi-layered golf balls having higher C.O.R.'s than those produced by the low acid ionomer inner cover compositions presently commercially available.

More particularly, several new metal cation neutralized high acid ionomer resins have been produced by the inventor by neutralizing, to various extents, high acid copolymers of an alpha-olefin and an alpha, beta-unsaturated carboxylic acid with a wide variety of different metal cation salts. This discovery is the subject matter of U.S. Application Serial No. 901,680, incorporated herein by reference. It has been found that numerous new metal cation neutralized high acid ionomer resins can be obtained by reacting a high acid copolymer (i.e. a copolymer containing greater than 16% by weight acid, preferably from about 17 to about 25 weight percent acid, and more preferably about 20 weight percent acid), with a metal cation salt capable of ionizing or neutralizing the copolymer to the extent desired (i.e. from about 10% to 90%).

The base copolymer is made up of greater than 16% by weight of an alpha, beta-unsaturated carboxylic acid and an alpha-olefin. Optionally, a softening comonomer can be included in the copolymer. Generally, the alpha-olefin has from 2 to 10 carbon atoms and is preferably ethylene, and the unsaturated carboxylic acid is a carboxylic acid having from about 3 to 8 carbons. Examples of such acids include acrylic acid, methacrylic acid,

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ethacrylic acid, chloroacrylic acid, crotonic acid, maleic acid, fumaric acid, and itaconic acid, with acrylic acid being preferred.

The softening comonomer that can be optionally included in the invention may be selected from the group consisting of vinyl esters of aliphatic carboxylic acids wherein the acids have 2 to 10 carbon atoms, vinyl ethers wherein the alkyl groups contains 1 to 10 carbon atoms, and alkyl acrylates or methacrylates wherein the alkyl group contains 1 to 10 carbon atoms. Suitable softening comonomers include vinyl acetate, methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, butyl acrylate, butyl methacrylate, or the like.

Consequently, examples of a number of copolymers suitable for use to produce the high acid ionomers included in the present invention include, but are not limited to, high acid embodiments of an ethylene/acrylic acid copolymer, an ethylene/methacrylic acid copolymer, an ethylene/itaconic acid copolymer, an ethylene/maleic acid copolymer, an ethylene/methacrylic acid/vinyl acetate copolymer, an ethylene/acrylic acid/vinyl alcohol copolymer, etc. The base copolymer broadly contains greater than 16% by weight unsaturated carboxylic acid, from about 30 to about 83% by weight ethylene and from 0 to about 40% by weight of a softening comonomer. Preferably, the copolymer contains about 20% by weight unsaturated carboxylic acid and about 80% by weight ethylene. Most preferably, the copolymer contains about 20% acrylic acid with the remainder being ethylene.

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Along these lines, examples of the preferred high acid base copolymers which fulfill the criteria set forth above, are a series of ethylene-acrylic copolymers which are commercially available from The Dow Chemical Company, Midland, Michigan, under the "Primacor" designation. These high acid base copolymers exhibit the typical properties set forth below in Table 1.

TABLE 1
Typical Properties of Primacor
Ethylene-Acrylic Acid Copolymers

GRADE	PERCENT ACID	DENSITY, g/cc	MELT INDEX, g/10min	TENSILE TD. ST (psi)	FLEXURAL MODULUS (psi)	VICAT SOFT PT (°C)	SHORE D HARDNESS
ASTM		0.792	0-1230	0-430	0-790	0-1525	0-2240
5920	20.0	0.958	300.0	-	4800	43	50
5990	20.0	0.955	1300.0	450	2600	40	42
5990	20.0	0.953	1300.0	450	3200	40	42
5981	20.0	0.960	300.0	900	3200	46	48
5981	20.0	0.960	300.0	900	3200	46	48
5983	20.0	0.958	300.0	850	3100	44	45
5991	20.0	0.953	2600.0	635	2600	38	40

*The Melt Index values are obtained according to ASTM D-1238, at 190°C.

Due to the high molecular weight of the Primacor 5981 grade of the ethylene-acrylic acid copolymer, this copolymer is the more preferred grade utilized in the invention.

The metal cation salts utilized in the invention are those salts which provide the metal cations capable of neutralizing, to various extents, the carboxylic acid groups of the high acid copolymer. These include acetate, oxide or hydroxide

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salts of lithium, calcium, zinc, sodium, potassium, nickel, magnesium, and manganese.

Examples of such lithium ion sources are lithium hydroxide monohydrate, lithium hydroxide, lithium oxide and lithium acetate. Sources for the calcium ion include calcium hydroxide, calcium acetate and calcium oxide. Suitable zinc ion sources are zinc acetate dihydrate and zinc acetate, a blend of zinc oxide and acetic acid. Examples of sodium ion sources are sodium hydroxide and sodium acetate. Sources for the potassium ion include potassium hydroxide and potassium acetate. Suitable nickel ion sources are nickel acetate, nickel oxide and nickel hydroxide. Sources of magnesium include magnesium oxide, magnesium hydroxide, magnesium acetate. Sources of manganese include manganese acetate and manganese oxide.

The new metal cation neutralized high acid ionomer resins are produced by reacting the high acid base copolymer with various amounts of the metal cation salts above the crystalline melting point of the copolymer, such as at a temperature from about 200° F to about 500° F, preferably from about 250° F to about 350° F under high shear conditions at a pressure of from about 10 psi to 10,000 psi. Other well known blending techniques may also be used. The amount of metal cation salt utilized to produce the new metal cation neutralized high acid based ionomer resins is the quantity which provides a sufficient amount of the metal cations to neutralize the desired percentage of the carboxylic acid groups in

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the high acid copolymer. The extent of neutralization is generally from about 10% to about 90%.

As indicated below in Table 2 and more specifically in Example 1 in U.S. Application Serial No. 901,680, a number of new types of metal cation neutralized high acid ionomers can be obtained from the above indicated process. These include new high acid ionomer resins neutralized to various extents with manganese, lithium, potassium, calcium and nickel cations. In addition, when a high acid ethylene/acrylic acid copolymer is utilized as the base copolymer component of the invention and this component is subsequently neutralized to various extents with the metal cation salts producing acrylic acid based high acid ionomer resins neutralized with cations such as sodium, potassium, lithium, zinc, magnesium, manganese, calcium and nickel, several new cation neutralized acrylic acid based high acid ionomer resins are produced.

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TABLE 2

<u>Formulation No.</u>	<u>Wt-% Cation Salt</u>	<u>Wt-% Neutralization</u>	<u>Melt Index</u>	<u>C.O.R.</u>	<u>Shore D Hardness</u>
1(NaOH)	6.98	67.5	0.9	.804	71
2(NaOH)	5.66	56.0	2.4	.808	73
3(NaOH)	3.84	35.9	12.2	.812	69
4(NaOH)	2.91	27.0	17.5	.812	(brittle)
5(HvAc)	19.6	71.7	7.5	.809	73
6(HvAc)	23.1	88.3	3.5	.814	77
7(HvAc)	15.3	53.0	7.5	.810	72
8(HvAc)	26.5	106	0.7	.813	(brittle)
9(LiOH)	4.54	71.3	0.6	.810	74
10(LiOH)	3.38	52.5	6.2	.810	72
11(LiOH)	2.34	35.9	18.6	.815	72
12(KOH)	5.38	36.0	19.3	Break	70
13(KOH)	8.26	57.9	7.18	.804	70
14(KOH)	10.7	77.0	4.3	.801	67
15(ZnAc)	17.9	71.5	0.2	.806	71
16(ZnAc)	13.9	53.0	0.9	.797	69
17(ZnAc)	9.91	36.1	3.4	.793	67
18(HgAc)	17.4	70.7	2.8	.814	74
19(HgAc)	20.6	87.1	1.5	.815	76
20(HgAc)	13.8	53.8	4.1	.814	74
21(CuAc)	13.2	69.2	1.1	.813	74
22(CuAc)	7.12	34.9	10.1	.808	70

Controls: 50/50 Blend of Ioleky 8000/7030 C.O.R.=.810/65 Shore D Hardness
 DuPont High Acid Surlym 8422 (Na) C.O.R.=.811/70 Shore D Hardness
 DuPont High Acid Surlym 8162 (Zn) C.O.R.=.807/63 Shore D Hardness
 Exxon High Acid Iolek EX-960 (Zn) C.O.R.=.796/63 Shore D Hardness

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TABLE 2 (continued)

<u>Formulation No.</u>	<u>Wt-% Cation Salt</u>	<u>Wt-% Neutralization</u>	<u>Melt Index</u>	<u>C.O.B.</u>
23(MgO)	2.91	53.3	2.5	.813
24(MgO)	3.85	71.5	2.0	.808
25(MgO)	4.76	89.3	1.1	.809
26(MgO)	1.96	35.7	7.3	.815

Control for Formulations 23-26 is 50/50 Iotek 8000/7030,
C.O.B.=.816, Formulation 26 C.O.B. was normalized to that control accordingly

TABLE 2 (continued)

<u>Formulation No.</u>	<u>Wt-% Cation Salt</u>	<u>Wt-% Neutralization</u>	<u>Melt Index</u>	<u>C.O.B.</u>	<u>Shore D Hardness</u>
27(HAc)	13.04	41.1	0.2	.802	71
28(HAc)	10.71	48.9	0.5	.799	72
29(HAc)	8.26	36.7	1.8	.796	69
30(HAc)	5.66	21.6	7.3	.786	64

Control for Formulation Nos. 27-30 is 50/50 Iotek 8000/7030, C.O.B.=.807

When compared to low acid versions of similar cation neutralized ionomer resins, the new metal cation neutralized high acid ionomer resins exhibit enhanced hardness, modulus and resilience characteristics. These are properties that are particularly desirable in a number of thermoplastic fields, including the field of golf ball manufacturing.

When utilized in the construction of the inner layer of a multi-layered golf ball, it has been found that the new acrylic acid based high acid ionomers extend the range of hardness beyond that previously obtainable while maintaining the beneficial properties (i.e. durability, click, feel, etc.) of the softer low acid ionomer covered balls, such as balls produced utilizing the

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low acid ionomers disclosed in U.S. Patent Nos. 4,884,814 and 4,911,451.

Moreover, as a result of the development of a number of new acrylic acid based high acid ionomer resins neutralized to various extents by several different types of metal cations, such as manganese, lithium, potassium, calcium and nickel cations, several new ionomers or ionomer blends are now available for production of an inner cover layer of a multi-layered golf ball. By using these high acid ionomer resins, harder, stiffer inner cover layers having higher C.O.R.'s, and thus longer distance, can be obtained.

More preferably, it has been found that when two or more of the above-indicated high acid ionomers, particularly blends of sodium and zinc high acid ionomers, are processed to produce the covers of multi-layered golf balls, (i.e., the inner cover layer herein) the resulting golf balls will travel further than previously known multi-layered golf balls produced with low acid ionomer resin covers due to the balls' enhanced coefficient of restitution values.

For example, the multi-layer golf ball taught in 4,650,193 does not incorporate a high acid ionomeric resin in the inner cover layer. As will be set forth below in the Examples, the coefficient of restitution of the golf ball having an inner layer taught by the '193 patent (i.e., inner layer composition "D" in the Examples) is substantially lower than the coefficient of restitution of the remaining compositions. In addition, the multi-

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layered ball disclosed in the '193 patent suffers substantially in durability in comparison with the present invention.

With respect to the outer layer 16 of the multi-layered cover of the present invention, the outer cover layer is comparatively softer than the high acid ionomer based inner layer. The softness provides for the feel and playability characteristics typically associated with balata or balata-blend balls. The outer layer or ply is comprised of a relatively soft, low modulus (about 1,000 psi to about 10,000 psi) and low acid (less than 16 weight percent acid) ionomer, ionomer blend or a non-ionomeric thermoplastic elastomer such as, but not limited to, a polyurethane, a polyester elastomer such as that marketed by DuPont under the trademark Hytrel®, or a polyester amide such as that marketed by Elf Atochem S.A. under the trademark Pebax®. The outer layer is fairly thin (i.e. from about 0.010 to about 0.050 in thickness, more desirably 0.03 inches in thickness for a 1.680 inch ball), but thick enough to achieve desired playability characteristics while minimizing expense.

Preferably, the outer layer includes a blend of hard and soft (low acid) ionomer resins such as those described in U. S. Patent Nos. 4,884,814 and 5,120,791, both incorporated herein by reference. Specifically, a desirable material for use in molding the outer layer comprises a blend of a high modulus (hard) ionomer with a low modulus (soft) ionomer to form a base ionomer mixture. A high modulus ionomer herein is one which measures from about 15,000 to about 70,000 psi as measured in accordance with ASTM

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method D-790. The hardness may be defined as at least 50 on the Shore D scale as measured in accordance with ASTM method D-2240.

A low modulus ionomer suitable for use in the outer layer blend has a flexural modulus measuring from about 1,000 to about 10,000 psi, with a hardness of about 20 to about 40 on the Shore D scale.

The hard ionomer resins utilized to produce the outer cover layer composition hard/soft blends include ionic copolymers which are the sodium, zinc, magnesium or lithium salts of the reaction product of an olefin having from 2 to 8 carbon atoms and an unsaturated monocarboxylic acid having from 3 to 8 carbon atoms. The carboxylic acid groups of the copolymer may be totally or partially (i.e. approximately 15-75 percent) neutralized.

The hard ionomeric resins are likely copolymers of ethylene and either acrylic and/or methacrylic acid, with copolymers of ethylene and acrylic acid being the most preferred. Two or more types of hard ionomeric resins may be blended into the outer cover layer compositions in order to produce the desired properties of the resulting golf balls.

As discussed earlier herein, the hard ionomeric resins introduced under the designation Escor® and sold under the designation "Iotek" are somewhat similar to the hard ionomeric resins sold under the Surlyn® trademark. However, since the "Iotek" ionomeric resins are sodium or zinc salts of poly(ethylene-acrylic acid) and the Surlyn® resins are zinc or sodium salts of poly(ethylene-methacrylic acid) some distinct differences in

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properties exist. As more specifically indicated in the data set forth below, the hard "Iotek" resins (i.e., the acrylic acid based hard ionomer resins) are the more preferred hard resins for use in formulating the outer layer blends for use in the present invention. In addition, various blends of "Iotek" and Surlyn® hard ionomeric resins, as well as other available ionomeric resins, may be utilized in the present invention in a similar manner.

Examples of commercially available hard ionomeric resins which may be used in the present invention in formulating the outer cover blends include the hard sodium ionic copolymer sold under the trademark Surlyn®8940 and the hard zinc ionic copolymer sold under the trademark Surlyn®9910. Surlyn®8940 is a copolymer of ethylene with methacrylic acid and about 15 weight percent acid which is about 29 percent neutralized with sodium ions. This resin has an average melt flow index of about 2.8. Surlyn®9910 is a copolymer of ethylene and methacrylic acid with about 15 weight percent acid which is about 58 percent neutralized with zinc ions. The average melt flow index of Surlyn®9910 is about 0.7. The typical properties of Surlyn®9910 and 8940 are set forth below in Table 3:

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TABLE 3

Typical Properties of Commercially Available Hard
Surllyn® Resins Suitable for Use in the Outer Layer Blends of
the Present Invention

	ASIM D	8960	9910	8920	8520	9970	9730
Cation Type		Sodium Zinc	Sodium	Sodium	Sodium	Zinc	Zinc
Melt flow index, gms/10 min.	D-1238	2.0	0.7	0.9	1.3	14.0	1.6
Specific Gravity, g/cm ³	D-792	0.95	0.97	0.95	0.94	0.91	0.95
Hardness, Shore D	D-2240	65	64	65	60	62	63
Tensile Strength, (kpsi), MPa	D-630	(4.0) 33.1	(3.6) 24.8	(3.6) 37.2	(4.2) 29.0	(3.2) 22.0	(4.1) 28.0
Elongation, %	D-630	470	290	350	450	460	460
Flexural Modulus, (kpsi) MPa	D-790	(51) 350	(48) 330	(55) 380	(32) 220	(28) 190	(30) 210
Tensile Impact (23°C) KJ/m ² (ft.-lb./in. ²)	D-10225	1020 (405)	1020 (405)	845 (400)	1160 (550)	760 (360)	1240 (590)
Vicat Temperature, °C	D-1525	61	62	50	73	61	73

Examples of the more pertinent acrylic acid based hard monomer resin suitable for use in the present outer cover composition sold under the "Iotek" tradename by the Exxon Corporation include Iotek 4000, Iotek 4010, Iotek 8000, Iotek 8020 and Iotek 8010. The typical properties of these and other Iotek hard monomers suited for use in formulating the outer layer cover composition are set forth below in Table 4:

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TABLE 4

Typical Properties of Iotek Ionomers

Resin Properties	ASTM						
	Method	Units	4000	4010	8000	8020	8030
Cation type			zinc	zinc	sodium	sodium	sodium
Melt Index	D-1238	g/10 min.	2.5	1.5	0.8	1.6	2.8
Density	D-1505	kg/m ³	963	963	934	960	960
Melting Point	D-3417	°C	90	90	90	87.5	87.5
Crystallization Point	D-3417	°C	62	64	56	53	55
Vicat Softening Point	D-1525	°C	62	63	61	64	67
% Weight Acrylic Acid			16		11		
% of Acid Groups cation neutralized			30		60		
Plaque Properties (3 mm thick, compression molded)	ASTM						
	Method	Units	4000	4010	8000	8020	8030
Tensile at break	D-638	MPa	24	26	36	31.5	28
Yield point	D-638	MPa	none	none	21	21	23
Elongation at break	D-638	%	395	420	350	410	395
1X Secant modulus	D-638	MPa	160	160	300	350	390
Shore Hardness D	D-2240	--	55	55	61	58	59
Film Properties (50 micron film 2.2:1 blow-up ratio)			4000	4010	8000	8020	8030
Tensile at Break	MD	D-882 MPa	41	39	42	52	47.6
	TD	D-882 MPa	37	38	38	38	40.5
Yield point	MD	D-882 MPa	15	17	17	23	21.6
	TD	D-882 MPa	14	15	15	21	20.7
Elongation at Break	MD	D-882 %	310	270	260	295	305
	TD	D-882 %	360	340	280	340	345
1X Secant modulus	MD	D-882 MPa	210	215	390	380	380
	TD	D-882 MPa	200	225	380	350	345
Port Drop Impact	D-1709	g/micron	12.4	12.5	20.3		

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<u>ASTM Properties</u>	<u>ASTM Method</u>	<u>Units</u>	<u>7010</u>	<u>7020</u>	<u>7030</u>
Cellion type			zinc	zinc	zinc
Melt Index	D-1238	g/10 min.	8.8	1.5	2.5
Density	D-1505	kg/m ³	960	960	960
Melting Point	D-3417	°C	98	98	98
Crystallization Point	D-3417	°C	--	--	--
Viscous Softening Point	D-1325	°C	60	63	62.5
Weight Acrylic Acid			--	--	--
% of Acid Groups Cation Neutralized			--	--	--
Plaque Resistance (3 mm thick, compression molded)	<u>ASTM Method</u>	<u>Units</u>	<u>7010</u>	<u>7020</u>	<u>7030</u>
Tensile at break	D-638	MPa	38	38	38
Yield Point	D-638	MPa	none	none	none
Elongation at break	D-638	%	900	420	395
1X Secant modulus	D-638	MPa	--	--	--
Shore Hardness D	D-2240	--	57	55	55

Comparatively, soft ionomers are used in formulating the hard/soft blends of the outer cover composition. These ionomers include acrylic acid based soft ionomers. They are generally characterized as comprising sodium or zinc salts of a terpolymer of an olefin having from about 2 to 8 carbon atoms, acrylic acid, and an unsaturated monomer of the acrylate ester class having from 1 to 21 carbon atoms. The soft ionomer is preferably a zinc based ionomer made from an acrylic acid based polymer in an unsaturated monomer of the acrylate ester class. The soft (low modulus) ionomers have a hardness from about 20 to about 40 as measured on

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the Shore D scale and a flexural modulus from about 1,000 to about 10,000, as measured in accordance with ASTM method D-790.

Certain ethylene-acrylic acid based soft ionomer resins developed by the Exxon Corporation under the designation "Iotek 7520" (referred to experimentally by differences in neutralization and melt indexes as LDX 195, LDX 196, LDX 218 and LDX 219) may be combined with known hard ionomers such as those indicated above to produce the outer cover. The combination produces higher C.O.R.s at equal or softer hardness, higher melt flow (which corresponds to improved, more efficient molding, i.e., fewer rejects) as well as significant cost savings versus the outer layer of multi-layer balls produced by other known hard-soft ionomer blends as a result of the lower overall raw materials costs and improved yields.

While the exact chemical composition of the resins to be sold by Exxon under the designation Iotek 7520 is considered by Exxon to be confidential and proprietary information, Exxon's experimental product data sheet lists the following physical properties of the ethylene acrylic acid zinc ionomer developed by Exxon:

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TABLE 5

Physical Properties of Iotek 7520

<u>Property</u>	<u>ASTM Method</u>	<u>Units</u>	<u>Typical Value</u>
Melt Index	D-1238	g/10 min.	2
Density	D-1505	kg/m ³	0.962
Cation			Zinc
Melting Point	D-3417	°C	66
Crystallization Point	D-3417	°C	49
Vicat Softening Point	D-1525	°C	42

Plaque Properties (2 mm thick Compression Molded Plaques)

Tensile at Break	D-638	MPa	10
Yield Point	D-638	MPa	None
Elongation at Break	D-638	%	760
1% Secant Modulus	D-638	MPa	22
Shore D Hardness	D-2240		32
Flexural Modulus	D-790	MPa	26
Zwick Rebond	ISO 4862	%	52
De Mattia Flex Resistance	D-430	Cycles	>5000

In addition, test data collected by the inventor indicates that Iotek 7520 resins have Shore D hardnesses of about 32 to 36 (per ASTM D-2240), melt flow indexes of 3±0.5 g/10 min (at 190°C. per ASTM D-1238), and a flexural modulus of about 2500-3500 psi (per ASTM D-790). Furthermore, testing by an independent

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testing laboratory by pyrolysis mass spectrometry indicates that Iotek 7520 resins are generally zinc salts of a terpolymer of ethylene, acrylic acid, and methyl acrylate.

Furthermore, the inventor has found that a newly developed grade of an acrylic acid based soft ionomer available from the Exxon Corporation under the designation Iotek 7510, is also effective, when combined with the hard ionomers indicated above in producing golf ball covers exhibiting higher C.O.R. values at equal or softer hardness than those produced by known hard-soft ionomer blends. In this regard, Iotek 7510 has the advantages (i.e. improved flow, higher C.O.R. values at equal hardness, increased clarity, etc.) produced by the Iotek 7520 resin when compared to the methacrylic acid base soft ionomers known in the art (such as the Surlyn 8625 and the Surlyn 8629 combinations disclosed in U.S. Patent No. 4,884,814).

In addition, Iotek 7510, when compared to Iotek 7520, produces slightly higher C.O.R. values at equal softness/hardness due to the Iotek 7510's higher hardness and neutralization. Similarly, Iotek 7510 produces better release properties (from the mold cavities) due to its slightly higher stiffness and lower flow rate than Iotek 7520. This is important in production where the soft covered balls tend to have lower yields caused by sticking in the molds and subsequent punched pin marks from the knockouts.

According to Exxon, Iotek 7510 is of similar chemical composition as Iotek 7520 (i.e. a zinc salt of a terpolymer of ethylene, acrylic acid, and methyl acrylate) but is more highly

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neutralized. Based upon FTIR analysis, Iotek 7520 is estimated to be about 10-40 wt.-% neutralized and Iotek 7510 is estimated to be about 40-60 wt.-% neutralized. The typical properties of Iotek 7510 in comparison of those of Iotek 7520 are set forth below:

TABLE 6

Physical Properties of Iotek 7510
in Comparison to Iotek 7520

	<u>IOTEK 7520</u>	<u>IOTEK 7510</u>
MI, g/10 min	2.0	0.8
Density, g/cc	0.96	0.97
Melting Point, °F	151	149
Vicat Softening Point, °F	108	109
Flex Modulus, psi	3800	5300
Tensile Strength, psi	1450	1750
Elongation, %	760	690
Hardness, Shore D	32	35

It has been determined that when hard/soft ionomer blends are used for the outer cover layer, good results are achieved when the relative combination is in a range of about 90 to about 10 percent hard ionomer and about 10 to about 90 percent soft ionomer. The results are improved by adjusting the range to about 75 to 25 percent hard ionomer and 25 to 75 percent soft ionomer. Even better results are noted at relative ranges of about 60 to 90 percent hard ionomer resin and about 40 to 60 percent soft ionomer resin.

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Specific formulations which may be used in the cover composition are included in the examples set forth in U. S. Patent No. 5,120,791 and 4,884,814. The present invention is in no way limited to those examples.

Moreover, in alternative embodiments, the outer cover layer formulation may also comprise a soft, low modulus non-ionomeric thermoplastic elastomer including a polyester polyurethane such as B.F. Goodrich Company's Estane® polyester polyurethane X-4517. According to B.F. Goodrich, Estane® X-4517 has the following properties:

Properties of Estane® X-4517

Tensile	1430
100%	815
200%	1024
300%	1193
Elongation	641
Youngs Modulus	1826
Hardness A/D	88/39
Dayshore Rebound	59
Solubility in Water	Insoluble
Melt processing temperature	>350°F (>177°C)
Specific Gravity (H ₂ O=1)	1.1-1.3

Other soft, relatively low modulus non-ionomeric thermoplastic elastomers may also be utilized to produce the outer cover layer as long as the non-ionomeric thermoplastic elastomers produce the playability and durability characteristics desired without adversely effecting the enhanced travel distance characteristic produced by the high acid ionomer resin composition.

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These include, but are not limited to thermoplastic polyurethanes such as: Texin thermoplastic polyurethanes from Mobay Chemical Co. and the Pellethane thermoplastic polyurethanes from Dow Chemical Co.; Ionomer/rubber blends such as those in Spalding U.S. Patents 4,986,545; 5,098,105 and 5,187,013; and, Hytrel polyester elastomers from DuPont and Pebax polyesteramides from Elf Atochem S.A.

In preparing golf balls in accordance with the present invention, a hard inner cover layer is molded (by injection molding or by compression molding) about a core (preferably a solid core). A comparatively softer outer layer is molded over the inner layer.

The conventional solid core is about 1.545 inches in diameter, although it can range from about 1.495 to about 1.575 inches. Conventional solid cores are typically compression molded from a slug of uncured or lightly cured elastomer composition comprising a high cis content polybutadiene and a metal salt of an α, β , ethylenically unsaturated carboxylic acid such as zinc mono or diacrylate or methacrylate. To achieve higher coefficients of restitution in the core, the manufacturer may include fillers such as small amounts of a metal oxide such as zinc oxide. In addition, larger amounts of metal oxide than those that are needed to achieve the desired coefficient are often included in conventional cores in order to increase the core weight so that the finished ball more closely approaches the U.S.G.A. upper weight limit of 1.620 ounces. Other materials may be used in the core composition including compatible rubbers or ionomers, and low molecular weight fatty

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acids such as stearic acid. Free radical initiators such as peroxides are admixed with the core composition so that on the application of heat and pressure, a complex curing cross-linking reaction takes place..

The inner cover layer which is molded over the core is about 0.100 inches to about 0.010 inches in thickness, preferably about 0.0375 inches thick. The outer cover layer is about 0.010 inches to about 0.050 inches in thickness, preferably 0.0300 inches thick. Together, the core, the inner cover layer and the outer cover layer combine to form a ball having a diameter of 1.680 inches or more, the minimum diameter permitted by the rules of the United States Golf Association and weighing about 1.620 ounces.

Additional materials may be added to the cover compositions (both inner and outer cover layer) of the present invention including dyes (for example, Ultramarine Blue sold by Whitaker, Clark and Daniels of South Plainsfield, N.J.) (see U.S. Patent No. 4,679,795); pigments such as titanium dioxide, zinc oxide, barium sulfate and zinc sulfate; and UV absorbers; antioxidants; antistatic agents; and stabilizers. Further, the cover compositions of the present invention may also contain softening agents, such as plasticizers, processing aids, etc. and reinforcing material such as glass fibers and inorganic fillers, as long as the desired properties produced by the golf ball covers are not impaired.

The various cover composition layers of the present invention may be produced according to conventional melt blending

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procedures. In the case of the outer cover layer, when a blend of hard and soft, low acid ionomer resins are utilized, the hard ionomer resins are blended with the soft ionomeric resins and with a masterbatch containing the desired additives in a Banbury mixer, two-roll mill, or extruder prior to molding. The blended composition is then formed into slabs and maintained in such a state until molding is desired. Alternatively, a simple dry blend of the pelletized or granulated resins and color masterbatch may be prepared and fed directly into the injection molding machine where homogenization occurs in the mixing section of the barrel prior to injection into the mold. If necessary, further additives such as an inorganic filler, etc., may be added and uniformly mixed before initiation of the molding process. A similar process is utilized to formulate the high acid ionomer resin compositions used to produce the inner cover layer.

The golf balls of the present invention can be produced by molding processes currently well known in the golf ball art. Specifically, the golf balls can be produced by injection molding or compression molding the inner cover layer about wound or solid molded cores to produce an intermediate golf ball having a diameter of about 1.50 to 1.67 inches, preferably about 1.620 inches. The outer layer is subsequently molded over the inner layer to produce a golf ball having a diameter of 1.680 inches or more. Although either solid cores or wound cores can be used in the present invention, as a result of their lower cost and superior performance, solid molded cores are preferred over wound cores.

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In compression molding, the inner cover composition is formed via injection at about 180°F to about 450°F into smooth surfaced hemispherical shells which are then positioned around the core in a mold having the desired inner cover thickness and subjected to compression molding at 200° to 300°F for about 2 to 10 minutes, followed by cooling at 50° to 70°F for about 2 to 7 minutes to fuse the shells together to form a unitary intermediate ball. In addition, the intermediate balls may be produced by injection molding wherein the inner cover layer is injected directly around the core placed at the center of an intermediate ball mold for a period of time in a mold temperature of from 50°F to about 100°F. Subsequently, the outer cover layer is molded about the core and the inner layer by similar compression or injection molding techniques to form a dimpled golf ball of a diameter of 1.680 inches or more.

After molding, the golf balls produced may undergo various further processing steps such as buffing, painting and marking as disclosed in U.S. Patent No. 4,911,451.

The resulting golf ball produced from the high acid ionomer resin inner layer and the relatively softer, low flexural modulus outer layer provide for an improved multi-layer golf ball which provides for desirable coefficient of restitution and durability properties while at the same time offering the feel and spin characteristics associated with soft balata and balata-like covers of the prior art.

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The present invention is further illustrated by the following examples in which the parts of the specific ingredients are by weight. It is to be understood that the present invention is not limited to the examples, and various changes and modifications may be made in the invention without departing from the spirit and scope thereof.

Examples

Several intermediate balls (cores plus inner cover layers) were prepared in accordance with conventional molding procedures described above. The inner cover compositions were molded around 1.545 inch diameter cores weighing 36.5 grams such that the inner cover had a wall thickness of about 0.0675 inches, with the overall ball measuring about 1.680 inches in diameter.

The cores utilized in the examples were comprised of the following ingredients: high cis-polybutadiene, zinc diacrylate, zinc oxide, zinc stearate, peroxide, calcium carbonate, etc. The molded cores exhibited Riehle compressions of about 60 and C.O.R. values of about .800. A representative formulation of the molded cores is set forth below:

<u>MATERIAL</u>	<u>WEIGHT</u>
BR-1220 (high cis-polybutadiene)	70.70
Isktene 220 (high cis-polybutadiene)	29.30
React Rile ZDA (zinc diacrylate)	31.14
Zinc Oxide	6.23
Zinc Stearate	20.15
Limestone	17.58
Ground Flash	20.15

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(20-40 Mesh)	
Blue Kesterbatch	.812
Lupercus 231XL or Trigonox 29/40	.89
Papi 94	.58

*Blue Kesterbatch consists of unknown compositions used only for internal identification purposes and has no effect on physical properties.

The inner cover compositions designated herein as compositions A-E utilized to formulate the intermediate balls are set forth in Table 7 below. The resulting molded intermediate balls were tested to determine the individual compression (Riehle), C.O.R., Shore C hardness, spin rate and cut resistance properties. These results are also set forth in Table 7 below.

The data of these examples are the average of twelve intermediate balls produced for each example. The properties were measured according to the following parameters:

Coefficient of restitution (C.O.R.) was measured by firing the resulting golf ball in an air canon at a velocity of 125 feet per second against a steel plate positioned 12 feet from the muzzle of the canon. The rebound velocity was then measured. The rebound velocity was divided by the forward velocity to give a coefficient of restitution.

Shore hardness was measured in accordance with ASTM test 2240.

Cut resistance was measured in accordance with the following procedure: A golf ball is fired at 135 feet per second against the leading edge of a pitching wedge wherein the leading edge radius is 1/32 inch, the loft angle is 51 degrees, the sole radius is 2.5 inches and the bounce angle is 7 degrees.

The cut resistance of the balls tested herein was evaluated on a scale of 1 to 5. The number 1 represents a cut that extends completely through the cover to the core. A 2 represents a cut that does not extend

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completely through the cover but that does break the surface. A 3 does not break the surface of the cover but does leave a permanent dent. A 4 leaves only a slight crease which is permanent but not as severe as 3. A 5 represents virtually no visible indentation or damage of any sort.

The spin rate of the golf ball was measured by striking the resulting golf balls with a pitching wedge or 9 iron wherein the club head speed is about 105 feet per second and the ball is launched at an angle of 26 to 34 degrees with an initial velocity of about 110 to 115 feet per second. The spin rate was measured by observing the rotation of the ball in flight using stop action Strobe photography.

Initial velocity is the velocity of a ball when struck at a hammer speed of 143.8 feet per second in accordance with a test as prescribed by the U.S.G.A.

As will be noted, compositions A, B and C include high acid ionomeric resins, with composition B further including zinc stearate. Composition D represents the inner layer (i.e. Surlyn 1605) used in U.S. Patent No. 4,431,193. Composition E provides a hard, low acid ionomeric resin.

The purpose behind producing and testing the balls of Table IV was to provide a subsequent comparison in properties with the multi-layer golf balls of the present invention.

Table 7

Holded Intermediate Golf Balls

Ingredients of Inner Cover Compositions		A	B	C	D	E
Iotek 959	50	50	--	--	--	--
Iotek 960	50	50	--	--	--	--
Zinc Stearate	--	50	--	--	--	--
Surlyn 8162	--	--	75	--	--	--
Surlyn 8422	--	--	25	--	--	--
Surlyn 1605	--	--	--	100	--	--

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Iotek 7030	--	--	--	--	50
Iotek 8000	--	--	--	--	50

Properties of Molded
Intermediate Balls

Compression	58.	58	60	63	62
C.O.R.	.811	.810	.807	.793	.801
Shore C Hardness	98	98	97	96	96
Spin Rate (R.P.H.)	7,167	6,250	7,903	8,337	7,956
Cut Resistance	4-5	4-5	4-5	4-5	4-5

As shown in Table 7 above, the high acid ionomer resin inner cover layer (molded intermediate balls A-C) have lower spin rates and exhibit substantially higher resiliency characteristics than the low acid ionomer resin based inner cover layers of balls D and E.

Multi-layer balls in accordance with the present invention were then prepared. Specifically, the inner cover compositions used to produce intermediate golf balls from Table 7 were molded over the solid cores to a thickness of about 0.0375 inches, thus forming the inner layer. The diameter of the solid core with the inner layer measured about 1.620 inches. Alternatively, the intermediate golf balls of Table 7 were ground down using a centerless grinding machine to a size of 1.620 inches in diameter to produce an inner cover layer of 0.0375 inches.

The size of 1.620 inches was determined after attempting to mold the outer cover layer to various sizes (1.600", 1.610", 1.620", 1.630" and 1.640") of intermediate (core plus inner layer) balls. It was determined that 1.620" was about the largest "intermediate" ball (i.e., core plus inner layer) which could be easily molded over with the soft outer layer materials of choice.

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The goal herein was to use as thin an outer layer as necessary to achieve the desired playability characteristics while minimizing the cost of the more expensive outer materials. However, with a larger diameter final golf ball and/or if the cover is compression molded, a thinner cover becomes feasible.

With the above in mind, an outer cover layer composition was blended together in accordance with conventional blending techniques. The outer layer composition used for this portion of the example is a relatively soft cover composition such as those listed in U.S. Patent No. 5,120,791. An example of such a soft cover composition is a 45% soft/55% hard low acid ionomer blend designated by the inventor as "TE-90". The composition of TE-90 is set forth as follows:

Outer Cover Layer Composition TE-90

Iotek 8000	22.7 weight %
Iotek 7030	22.7 weight %
Iotek 7520	45.0 weight %
White MB ¹	9.6 weight %

¹White MB consists of about 23.77 weight percent TiO₂; 0.22 weight percent Uvitex OB, 0.03 weight percent Santonox R, 0.05 weight percent Ultramarine blue and 75.85 weight percent Iotek 7030.

The above outer layer composition was molded around each of the 1.620 diameter intermediate balls comprising a core plus one of compositions A-D, respectively. In addition, for comparison purposes, Surlyn® 1855 (new Surlyn® 9020), the cover composition of the '193 patent, was molded about the inner layer of composition D

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(the intermediate ball representative of the '193 patent). The outer layer TE-90 was molded to a thickness of approximately 0.030 inches to produce a golf ball of approximately 1.680 inches in diameter. The resulting balls (a dozen balls for each example) were tested and the various properties thereof are set forth in Table 8 as follows:

Table 8Finished Balls

<u>Ingredients:</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Inner Cover Composition	A	D	C	D	D
Outer Cover Composition	TE-90	TE-90	TE-90	TE-90	Suriyo 9020
<u>Properties of Molded Finished Balls:</u>					
Compression	63	63	69	70	61
C.O.R.	.784	.778	.780	.770	.757
Shore C Hardness	88	88	88	88	89
Spin (R.P.M.)	8,825	8,854	8,816	8,990	8,846
Cut Resistance	3-4	3-4	3-4	3-4	1-2

As it will be noted in finished balls 1-4, by creating a multi-layer cover utilizing the high acid ionomer resins in the inner cover layer and the hard/soft low acid ionomer resin in the outer cover layer, higher compression and increased spin rates are noted over the single layer covers of Table 7. In addition, both the C.O.R. and the Shore C hardness are reduced over the respective single layer covers of Table IV. This was once again particularly true with respect to the multi-layered balls containing the high

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acid ionomer resin in the inner layer (i.e. finished balls 1-5). In addition, with the exception of prior art ball 5 (i.e. the '193 patent), resistance to cutting remains good but is slightly decreased. As note above, the prior art ball of the '193 patent suffers substantially in durability (as well as in resiliency) in comparison to the balls of the present invention.

Furthermore, it is also noted that the use of the high acid ionomer resins as the inner cover material produces a substantial increase in the finished balls overall distance properties. In this regard, the high acid ionomer resin inner covers of balls 1-3 produce an increase of approximately 10 points in C.O.R. over the low acid ionomer resin inner covers of balls 4 and about a 25 point increase over the prior art balls 5. Since an increase in 3 to 6 points in C.O.R. results in an average increase of about 1 yard in distance, such an improvement is deemed to be significant.

Several other outer layer formulations were prepared and tested by molding them around the core and inner cover layer combination to form balls each having a diameter of about 1.68 inches. First, B.F. Goodrich Estane® X-4517 polyester polyurethane was molded about the core molded with inner layer cover formulation A. DuPont Surlyn® 9020 was molded about the core which was already molded with inner layer D. Similar properties tests were conducted on these golf balls and the results are set forth in Table VI below:

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Table 2Finish Balls

<u>Ingredients:</u>	<u>6</u>	<u>7</u>
Inner Cover Layer Composition	A	B
Outer Cover Layer Composition	Estane® 4517	Surlyn® 9020
<u>Properties of Molded finished Balls:</u>		
Compression	67	61
C.O.R.	.774	.757
Shore C Hardness	74	89
Spin (R.P.M.)	10,041	0,846
Cut Resistance	3-4	1-2

The ball comprising inner layer formulation D and Surlyn® 9020 identifies the ball in the Nesbitt 4,431,193 patent. As is noted, the example provides for relatively high softness and spin rate though it suffers from poor cut resistance and low C.O.R. This ball is unacceptable by today's standards.

As for the Estane® X-4517 polyester polyurethane, a significant increase in spin rate over the TE-90 cover is noted along with an increased compression. However, the C.O.R. and Shore C values are reduced, while the cut resistance remains the same. Furthermore, both the Estane® X-4517 polyester polyurethane and the Surlyn® 9020 were relatively difficult to mold in such thin sections.

The invention has been described with reference to the preferred embodiment. Modifications and alterations will occur to others upon reading and understanding the proceeding

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detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

The qualifications "about" and "substantially" include the precise values, and precise values include values about or substantially the same as the precise values.

The present disclosure includes the foregoing description, and the appended claims, drawings, and abstract.

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CLAIMS

1. A golf ball comprising:
 - a core;
 - an inner cover layer molded on said core, the inner cover layer comprising a high acid ionomer including at least 16% by weight of an alpha, beta-unsaturated carboxylic acid; and
 - an outer cover layer molded on said inner cover layer, said outer cover layer comprising a relatively soft polymeric material selected from the group consisting of low flexural modulus ionomer resins and non-ionomeric thermoplastic elastomers.
2. A golf ball according to claim 1 wherein the inner cover layer comprises a high acid ionomer resin comprising a copolymer of about 17% to about 25% by weight of an alpha, beta-unsaturated carboxylic acid.
3. A golf ball according to claim 1 wherein the inner cover layer comprises a high acid ionomer resin comprising a copolymer of about 18.5% to about 21.5% by weight of an alpha, beta-unsaturated carboxylic acid.
4. A golf ball according to claim 1, wherein the inner cover layer has a thickness of about 0.100 to about 0.010 inches and the outer cover layer has a thickness of about 0.010 to about

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0.05 inches, the golf ball having an overall diameter of 1.680 inches or more.

5. A golf ball according to claim 1 wherein the inner cover layer has a thickness of about 0.300 inches and the outer cover layer has a thickness of about 0.375 inches, the golf ball having an overall diameter of 1.680 inches or more.

6. A golf ball according to claim 1 wherein the outer layer comprises a low flexural modulus ionomer resin which includes a blend of a hard high modulus ionomer with a soft low modulus ionomer, the high modulus ionomer being a sodium, zinc, magnesium or lithium salt of a copolymer having from 2 to 8 carbon atoms and an unsaturated monocarboxylic acid having from 3 to 8 carbon atoms, the low modulus ionomer being a sodium or zinc salt of a terpolymer of an olefin having 2 to 8 carbon atoms, acrylic acid and an unsaturated monomer of the acrylate ester class having from 1 to 21 carbon atoms.

7. A golf ball according to claim 6 wherein the outer layer composition includes 90 to 10 percent by weight of the hard high modulus ionomer resin and about 10 to 90 percent by weight of the soft low modulus ionomer resin.

8. A golf ball according to claim 6 wherein the outer layer composition includes 75 to 25 percent by weight of the hard

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high modulus ionomer resin and about 25 to 75 percent by weight of the soft low modulus ionomer resin.

9. A golf ball according to claim 1 wherein the non-ionomeric thermoplastic elastomer is a polyester polyurethane.

10. A golf ball according to claim 1 wherein the non-ionomeric thermoplastic elastomer is a polyester elastomer.

11. A golf ball according to claim 1 wherein the non-ionomeric thermoplastic elastomer is a polyester amide.

12. A multi-layer golf ball comprising:

a spherical core;

an inner cover layer molded over said spherical core, said inner cover layer comprising an ionomeric resin including at least 16% by weight of an alpha, beta-unsaturated carboxylic acid and having a modulus of from about 15,000 to about 70,000 psi;

an outer cover layer molded over said spherical intermediate ball to form a multi-layer golf ball, the outer layer comprising a blend of i) a sodium or zinc salt of a copolymer having from 2 to 8 carbon atoms and an unsaturated monocarboxylic acid having from 3 to 8 carbon atoms, and ii) a sodium or zinc salt of a terpolymer of an olefin having 2 to 8 carbon atoms, acrylic acid and an unsaturated monomer of the

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acrylate ester class having from 1 to 21 carbon atoms, said outer cover layer having a modulus in a range of about 1,000 to about 30,000 psi.

13. A multi-layer golf ball comprising:

a spherical core;

an inner cover layer molded over said spherical core to form a spherical intermediate ball, said inner cover layer comprising an ionomeric resin including about 17% to about 25% by weight of an alpha, beta-unsaturated carboxylic acid and having a modulus of from about 15,000 to about 70,000 psi;

an outer cover layer molded over said spherical intermediate ball to form a multi-layer golf ball, the outer layer comprising a non-ionomeric thermoplastic selected from the group consisting of polyester elastomer, polyester polyurethane and polyester amide, said outer cover layer having a modulus in a range of about 1,000 to about 30,000 psi.

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14. A multi-layer golf ball comprising a core, an inner cover layer and an outer cover layer, wherein the inner cover layer is comprised of a high acid ionomer or ionomer blend which may or may not include a filler (e.g. zinc-stearate), and the outer cover layer is comprised of a soft, very low modulus ionomer or ionomer blend, or a non-ionomeric thermoplastic elastomer (e.g. polyurethane, polyester, or polyesteramide.

15. A golf ball according to claim 1, substantially as hereinbefore described.

16. A golf ball according to claim 12, substantially as hereinbefore described.

17. A golf ball according to claim 13, substantially as hereinbefore described.

18. A golf ball according to claim 14, substantially as hereinbefore described.

19. A golf ball, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

EXHIBIT 31

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Sullivan)	
Reexamination Proceeding)	
Control No.: 95/000,120)	Examiner: Michael W. O'Neill
Filed: January 17, 2006)	Art Unit: 3993
For: U.S. Patent No. 6,210,293)	

In re Sullivan)	
Reexamination Proceeding)	
Control No.: 95/000,121)	Examiner: Michael W. O'Neill
Filed: January 17, 2006)	Art Unit: 3993
For: U.S. Patent No. 6,503,156)	

In re Sullivan)	
Reexamination Proceeding)	
Control No.: 95/000,122)	Examiner: Michael W. O'Neill
Filed: January 17, 2006)	Art Unit: 3993
For: U.S. Patent No. 6,506,130)	

In re Sullivan)	
Reexamination Proceeding)	
Control No.: 95/000,123)	Examiner: Michael W. O'Neill
Filed: January 17, 2006)	Art Unit: 3993
For: U.S. Patent No. 6,595,873)	

Central Reexamination Unit
571-273-9900

DECLARATION OF WILLIAM J MACKNIGHT UNDER 37 C.F.R. §1.132

I, William J. MacKnight, state as follows:

1. I have been asked by third party requestor Acushnet to provide a declaration in connection with its Third Party Comments after Patent Owner Response to the USPTO Office actions regarding U.S. Patent Nos. 6,210,293 ("the '293 patent"), 6,503,156 ("the '156 patent"), 6,506,130 ("the '130 patent"), and 6,595,873 ("the '873 patent") (collectively the "Sullivan patents"). I have personal knowledge of the matters discussed herein, and I would testify to them under oath if called upon to do so.

2. I hold the position of Wilmer D. Barrett Distinguished Professor (Emeritus) in the Polymer Science and Engineering Department at the University of Massachusetts. I have been a professor at the University of Massachusetts since 1965, and was named Wilmer D. Barrett Distinguished Professor in 1998.

3. My educational background is summarized as follows:

1958: B.S. in Chemistry (with Distinction), University of Rochester

1963: M.A. in Chemistry, Princeton University

1964: Ph.D. in Physical Chemistry, Princeton University

1964: NSF Cooperative Fellow, Princeton University

4. I consider myself an expert in the field of polymer science, based on my years of teaching and research in that area.

5. I understand Acushnet has presented arguments to the USPTO regarding the patentability of the Sullivan Patents in relation to several prior art references, including U.S. Patent No. 4,431,193 to Nesbitt ("Nesbitt 193"), U.S. Patent No. 5,314,187 to Proudfit ("Proudfit 187"), U.S. Patent No. 4,274,637 to Molitor ("Molitor 637"), U.S. Patent No. 5,334,673 to Wu ("Wu 673"), and U.S. Patent No. 4,674,751 to Molitor ("Molitor 751").

6. I was asked by Acushnet and its lawyers to direct the preparation and testing of certain golf balls that are described by the patents listed above, or combinations thereof. I have personally directed the preparation and testing of the materials and golf balls described herein.

PREPARATION OF GOLF BALLS

7. At my direction, technical personnel at Acushnet's Research and Development department created several golf balls to be tested for Shore D hardness of the outer cover layer, as measured on the surface of the ball. In particular, I directed the preparation of twelve (12) samples each of nine (9) constructions of golf balls with various combinations of core formulation and diameter, inner cover layer formulation and thickness, and outer cover layer formulation and thickness.

PREPARATION OF MATERIALS TO BE USED IN THE GOLF BALLS

8. I directed the preparation of two types of golf ball core materials. The first golf ball core material is based on the disclosure of Nesbitt 193. In particular, the core material has the following composition:

Material	Weight
Polybutadiene (BR-1220)	70.70
Polybutadiene (Taktene 220)	29.30
Zinc Diacrylate	31.14
Zinc Oxide	6.23
Zinc Stearate	20.15
Limestone	17.58
Ground Flash	20.15
Blue Masterbatch	0.012
Luperco 231 XL	0.89

This composition is based on the core composition set forth in the Sullivan patents, for example, '293 patent, col. 16:15-30. I based this core composition on that set forth in the Sullivan patents to represent the Nesbitt 193 core for two reasons. First, Nesbitt 193 does not set forth any core composition. Second, the Sullivan patents describe balls using this core composition as "representative of the [Nesbitt] '193 patent" and as "the prior art ball of the [Nesbitt] '193 patent." See, for example, '293 patent, col. 18:33-35; col. 19:6-8. The only difference between the core composition set forth above and that set forth in the Sullivan patents as representing the Nesbitt 193 core is that the composition above does not include Papi 94, while the Sullivan patents describe using a small (0.50 by weight) amount of Papi 94 in its description of the core composition. See, for example, '293 patent, col. 16:28. I decided not to use any Papi 94 in the composition of this core because of the difficulty of obtaining the

substance and the fact that it is a dangerous substance to work with. In my opinion, based on my experience, the absence of 0.50 by weight of Papi 94 in the core composition would have negligible or no effect on any measurements of hardness of the outer cover layer of a formed ball using that core composition. I will refer to this core material herein as **CORE_1**.

9. The second golf ball core material that was prepared at my direction is based on the disclosure of Proudfit 187. In particular, the core has the following composition:

Material	Weight
Polybutadiene (Taktene 220)	95.00
Vestenamer 8012	5.00
Zinc Oxide	12.20
Zinc Diacrylate	35.00
Antioxidant	0.80
Peroxide (Luperco 101 XL)	0.080
Liquid Monomer SR-351	5.00

This composition is set forth in Table 5 of Proudfit 187, col. 7: 56-68. I will refer to this core material herein as **CORE_2**.

10. I directed the preparation of three inner cover layer materials. The first inner cover layer material is based on the disclosure of Nesbitt 193. In particular, the inner cover layer material is Surlyn 8940 (formerly Surlyn 1605), which is described in Nesbitt 193, col. 3:26-30. I will refer to this inner cover layer material herein as **ICL_1**.

11. The second type of inner cover layer material that was prepared at my direction is based on the disclosure of Molitor 637. In particular, the inner cover layer material has the following composition:

Material	Parts
Surlyn 1605 (now 8940)	88.00
Surlyn 1557 (now 9650)	17.40
TiO2 Master Batch A	35.20
Blowing Agent Master Batch B	2.32

This composition is described in Molitor 637 in Table 2, col. 14:60-65. I will refer to this inner cover layer material herein as ICL_2.

12. The third type of inner cover layer material that was prepared at my direction is based on the disclosure of Proudfit 187. In particular, the inner cover layer material has the following composition:

Material	Blend Ratio
Surlyn 8940	75%
Surlyn 9910	25%

This composition is described in Proudfit 187 in Table 6, col. 8:25-30. I will refer to this inner cover layer material herein as ICL_3.

13. I directed the preparation of three outer cover layer materials. The first outer cover layer material is based on the disclosure of Molitor 637. In particular, the outer cover layer material has the following composition:

Material	Parts
Estane 58133	99.7
Ficel EPA	0.3

This composition is described in Molitor 637 in Table 10, col. 18:36-41. I will refer to this outer cover layer material herein as OCL_1.

14. The second outer cover layer material that was prepared at my direction is based on the disclosure of Wu 673. In particular, the outer cover layer material has the following composition:

Material	Grams
MDI prepolymer	100.00
Polamine 250	48.87
White dispersion	5.21

This composition is described in Wu 673 in Table I, col. 7:15-23. I will refer to this outer cover layer material herein as **OCL 2**.

15. The third outer cover layer material that was prepared at my direction is based on Molitor 751. In particular, the outer cover layer material has the following composition:

Material	Parts
Texin 480 AR (now 285)	90
Surlyn 1605 (now 8940)	10
TiO ₂	5
Fluorescent Brightener	0.10
Antioxidant	0.17
Pigment	0.02
Release Agent	1

This composition is based on Example 4 in the Table in Molitor 751, Col. 7-8:1-24. The only difference between this cover layer composition and that disclosed as Example 4 in Molitor 751 is that Example 4 used 10 parts of Surlyn 1702 (which is now designated 9970) rather than 10 parts of Surlyn 1605 (now 8940). Surlyn 1702 (now 9970) is disclosed in Molitor 751 as

having a Shore D hardness of 62, whereas Surlyn 1605 (now 8940) is disclosed in Molitor 751 as having a Shore D hardness of 65. These Shore D hardness properties are consistent with those set forth in the Dupont data sheet for its Surlyn resins. Accordingly, in my opinion, any hardness measurements of the material disclosed in Example 4 of Molitor 751 would be even softer (i.e. lower on the Shore D scale) than such measurements of the cover layer material that was prepared at my direction. I will refer to this outer cover layer material herein as **OCL_3**.

PREPARATION OF GOLF BALLS

16. At my direction, Acushnet personnel made golf balls using the materials described above. I directed Acushnet personnel to make nine (9) constructions of golf balls, and for each type of golf ball construction, twelve (12) sample balls were made.

17. The first golf ball construction used the Nesbitt 193 core material (**CORE_1**), the Nesbitt 193 inner cover layer material (**ICL_1**), and the Molitor 637 outer cover layer material (**OCL_1**). I directed Acushnet personnel to make the ball with a core diameter of 1.495 inches, an inner cover layer thickness of 0.035 inches, and an outer cover layer of 0.0575 inches. This is consistent with the description in Nesbitt 193. Specifically, Nesbitt 193 describes a core and inner cover layer whose total diameter is about 1.565 inches (which is consistent with a core whose diameter is 1.495 inches and an inner cover layer whose thickness is 0.035 inches). Nesbitt 193, col. 3:26-30. Nesbitt 193 also describes an outer cover layer whose thickness is 0.0575 inches, for a total ball diameter of 1.680 inches. Nesbitt 193, col. 3:39-40. I refer to this ball construction herein as **BALL_1**. Twelve (12) samples of these balls were made at my direction.

18. The second golf ball construction used the Nesbitt 193 core material (**CORE_1**), the Nesbitt 193 inner cover layer material (**ICL_1**), and the Wu 673 outer cover layer material (**OCL_2**). I directed Acushnet personnel to make the ball with a core diameter of 1.495 inches, an inner cover layer thickness of 0.035 inches, and an outer cover layer of 0.0575 inches. As set forth above, this is consistent with the description in Nesbitt 193. I refer to this ball construction herein as **BALL_2**. Twelve (12) samples of these balls were made at my direction.

19. The third golf ball construction used the Nesbitt 193 core material (**CORE_1**), the Nesbitt 193 inner cover layer material (**ICL_1**), and the Molitor 751 outer cover layer material (**OCL_3**). I directed Acushnet personnel to make the ball with a core diameter of 1.495 inches, an inner cover layer thickness of 0.035 inches, and an outer cover layer of 0.0575 inches. As set forth above, this is consistent with the description in Nesbitt 193. I refer to this ball construction herein as **BALL_3**. Twelve (12) samples of these balls were made at my direction.

20. The fourth golf ball construction used the Nesbitt 193 core material (**CORE_1**), the Molitor 637 inner cover layer material (**ICL_2**), and the Molitor 637 outer cover layer material (**OCL_1**). I directed Acushnet personnel to make the ball with a core diameter of 1.495 inches, an inner cover layer thickness of 0.035 inches, and an outer cover layer of 0.0575 inches. As set forth above, this is consistent with the description in Nesbitt 193. I refer to this ball construction herein as **BALL_4**. Twelve (12) samples of these balls were made at my direction.

21. The fifth golf ball construction used the Nesbitt 193 core material (**CORE_1**), the Molitor 637 inner cover layer material (**ICL_2**), and the Wu 673 outer cover layer material (**OCL_2**). I directed Acushnet personnel to make the ball with a core diameter of 1.495 inches, an inner cover layer thickness of 0.035 inches, and an outer cover layer of 0.0575 inches. As set forth above, this is consistent with the description in Nesbitt 193. I refer to this ball construction herein as **BALL_5**. Twelve (12) samples of these balls were made at my direction.

22. The sixth golf ball construction used the Nesbitt 193 core material (**CORE_1**), the Molitor 637 inner cover layer material (**ICL_2**), and the Molitor 751 outer cover layer material (**OCL_3**). I directed Acushnet personnel to make the ball with a core diameter of 1.495 inches, an inner cover layer thickness of 0.035 inches, and an outer cover layer of 0.0575 inches. As set forth above, this is consistent with the description in Nesbitt 193. I refer to this ball construction herein as **BALL_6**. Twelve (12) samples of these balls were made at my direction.

23. The seventh golf ball construction used the Proudfit 187 core material (**CORE_2**), the Proudfit 187 inner cover layer material (**ICL_3**), and the Molitor 637 outer cover layer material (**OCL_1**). I directed Acushnet personnel to make the ball with a core

diameter of 1.5 inches, an inner cover layer thickness of 0.0375 inches, and an outer cover layer of 0.0525 inches. This is consistent with the description in Proudfit 187. Specifically, Proudfit 187 describes a core and inner cover layer whose total diameter is 1.575 inches (which is consistent with a core whose diameter is 1.5 inches and an inner cover layer whose thickness is 0.0375 inches). Proudfit 187, col. 7:43-47. Proudfit 187 also describes an outer cover layer whose thickness is 0.0525 inches, for a total ball diameter of 1.680 inches. Proudfit 187, col. 7:43-47. I refer to this ball construction herein as **BALL_7**. Twelve (12) samples of these balls were made at my direction.

24. The eighth golf ball construction used the Proudfit 187 core material (**CORE_2**), the Proudfit 187 inner cover layer material (**ICL_3**), and the Wu 673 outer cover layer material (**OCL_2**). I directed Acushnet personnel to make the ball with a core diameter of 1.5 inches, an inner cover layer thickness of 0.0375 inches, and an outer cover layer of 0.0525 inches. As set forth above, this is consistent with the description in Proudfit 187. I refer to this ball construction herein as **BALL_8**. Twelve (12) samples of these balls were made at my direction.

25. The ninth golf ball construction used the Proudfit 187 core material (**CORE_2**), the Proudfit 187 inner cover layer material (**ICL_3**), and the Molitor 751 outer cover layer material (**OCL_3**). I directed Acushnet personnel to make the ball with a core diameter of 1.5 inches, an inner cover layer thickness of 0.0375 inches, and an outer cover layer of 0.0525 inches. As set forth above, this is consistent with the description in Proudfit 187. I refer to this ball construction herein as **BALL_9**. Twelve (12) samples of these balls were made at my direction.

26. All golf balls made at my direction were made with a dimple pattern, and were painted and finished.

TESTING OF GOLF BALLS

27. I accompanied Acushnet personnel to an independent third-party plastics testing laboratory to provide the golf balls that were made at my direction for testing. The laboratory is called Plastics Technology Laboratories, Inc. (PTLI). I personally inspected the test equipment